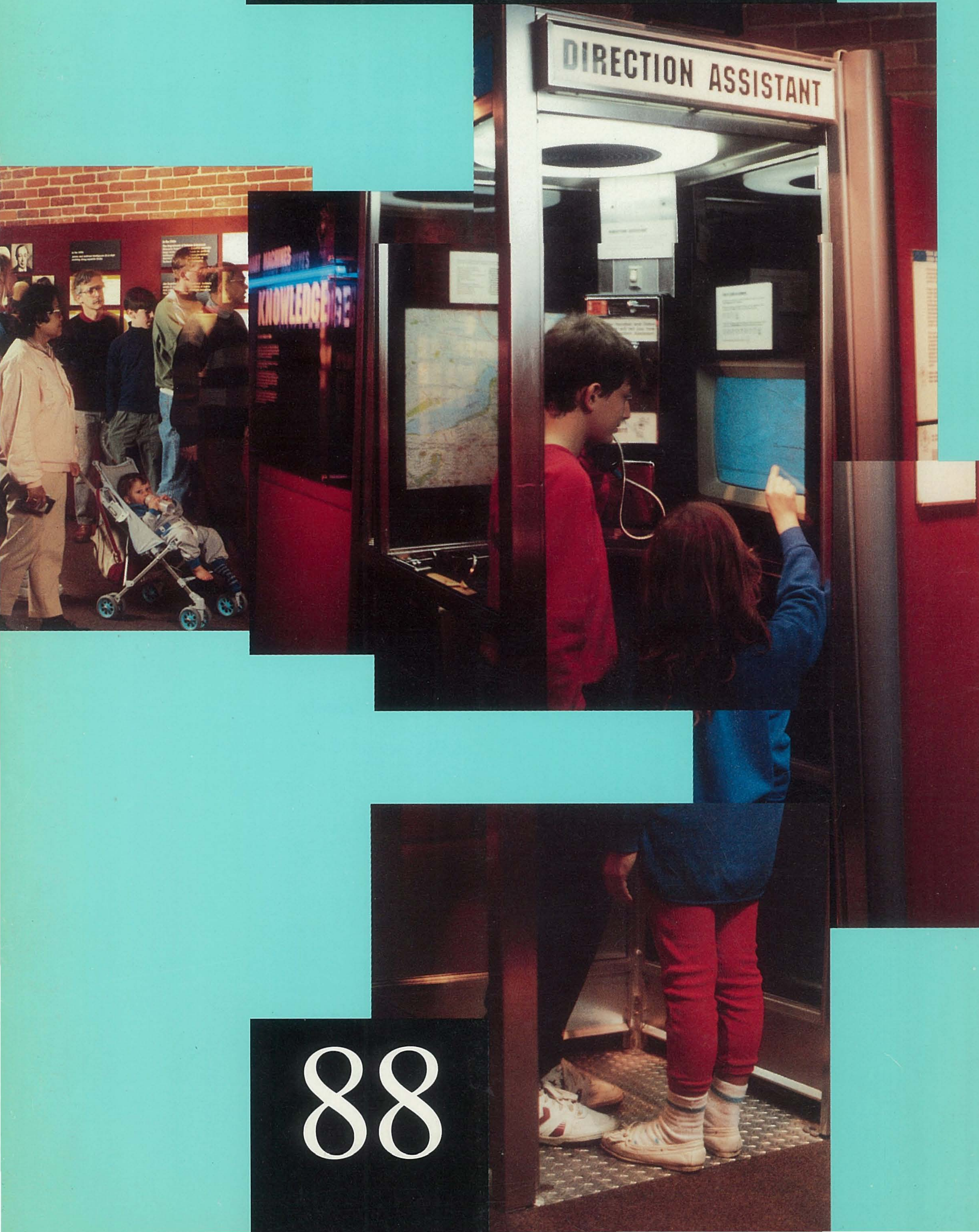
THE COMPUTER MUSEUM ANNUAL



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The
Computer
Museum

The Computer Museum Annual is the culmination of a year's effort on the part of many.

In particular, we would like to extend thanks to:

Advanced Computer Graphics, for providing typesetting.

Aetna Printing Services, for printing the Annual.

Boris Color Labs, for photo prints.

DesignSystems, of Cambridge, which designed and produced the *Annual.*

Martha Everson, who photographed the SAGE exhibit on page 13 and the Computer Bowl on page 7.

Stu Rosner, who photographed the *Annual* cover, the portraits on pages 1, 3, 8, 9 & 12, and items from the collection on pages 21, 23, 24, & 25.

Other photographs:

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Duane Winfield

p. 14
Barry Stark

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Arthur M. Riehl

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Duane Winfield,
Linda Holekamp

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Steve Nelson,
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Duane Winfield

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Linda Holekamp

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Marjorie Nelson

The Computer Museum

Founded in 1979, The Computer Museum is an international collecting and exhibiting museum. The only museum in the world devoted solely to computers, it was incorporated as an independent non-profit educational institution in 1982.

The Museum has assembled the most extensive collection of historical computers and robots in the world. Open to the public in downtown Boston since November 1984, the Museum welcomes over 100,000 visitors each year from around the globe.

The Museum's mission is three-fold:

To educate and inspire all ages and levels of the public through dynamic exhibitions and programs on the technology, applications and impact of computers.

To preserve and celebrate the history and promote the understanding of computers worldwide.

To be an international resource for research into the history of computing.

The history and current application of computers is presented in over 19,000 square feet of temporary and permanent exhibition space. The historical exhibits make ample use of the Museum's rare and growing collection. Some 60 hands-on exhibits enliven the visitor experience and provide a window on the future of computer technology.

The Museum brings its message to a wide and varied public through a program of daily demonstrations and guided tours, frequent lectures, workshops and events, and a national program of traveling exhibits.

Each year, over forty thousand students are introduced to the world of computing at the Museum. Teacher workshops empower educators to expand their students' use, understanding and appreciation of computers. An active outreach program sends museum educators into the schools with programs on computers and robots. Educational materials for the classroom are distributed nationally.

The Museum is funded through corporate and individual support, admissions, foundation and government grants. Members receive a bi-monthly newsletter and *The Computer Museum Annual*, a richly illustrated report of the Museum's activities.

Located on Museum Wharf at 300 Congress Street, Boston, Massachusetts, the Museum is easily accessible by public transportation and is only minutes away from Logan International Airport and Boston's financial district.

Public open hours are Tuesday through Sunday, 10 am - 5 pm, Friday until 9 pm, and daily during the summer.

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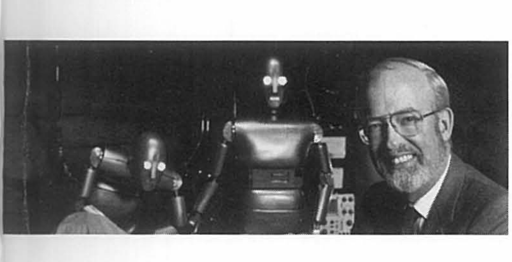

THE NEXT FIVE YEARS

Gardner C. Hendrie
Chairman,
The Computer Museum

The Computer Museum has certainly come a long way from its early days in Marlboro with its collection of early computers. It now has a wide range of interactive exhibits in both the Smart Machines Gallery as well as the Graphics Gallery. These exhibits help to expand the audience for the Museum from technically trained people who have grown up in the computer industry to include both children and adults who are curious about computers and how they work and how they are used.

The two primary challenges which I see for the next five years are:

1. To further expand the audience of the Museum in terms of both the age and background of our visitors.
2. To expand support for the Museum to include individuals, foundations, and corporations that span all segments of the computing community, both suppliers and users.

To achieve these goals we need to:

1. Continue to expand and improve our exhibits. Oliver Strimpel's article describes the new exhibits that will be devoted to history, will explain how computers work and will illustrate new and significant applications.
2. Create exhibits, events, and materials that allow us to share our collection and resources with organizations around the world. One of these is an exhibit on pocket calculators which is currently traveling throughout the country. The Computer Bowl was a simultaneous East and West Coast event that was later shown as two programs of the PBS show *Computer Chronicles*; the questions and answers were reproduced in *The Communications of the ACM.*
3. Develop the Museum's Education Department. Adeline Naiman, the new education director has a long list of programs currently being developed for school-age visitors.
4. Expand the involvement of the business community through innovative programs such as our breakfast seminars. These seminars bring industry luminaries to the Museum to talk about what is happening in computing today, and what may lie in the future.
5. Complete Phase II of the Museum's Capital Campaign. This Campaign is the principle means for funding the expansion of the Museum's programs. In the first year, we successfully raised over 1.2 million dollars. However, we still have a long way to go to successfully reach our goal of seven million by 1992.
6. Broaden the participation of individuals and corporations in the Museum's programs. Volunteer activities in public relations, collections and exhibit development have occurred from Louisville, Kentucky to Newcastle, England.
7. Promote pro-active collecting. The Museum has a preeminent collection from the 1950s and '60s and all of the very earliest PCs. However, we need to add the important advances of the '70s and '80s.

These programs will help us achieve the goals of The Computer Museum over the next few years. The most important element, however, is you: the member, the contributor, the visitor, the volunteer.

The Computer Museum Staff

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Executive Director

Gwen K. Bell
Founding President

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Valerie Freitas
Membership Coordinator

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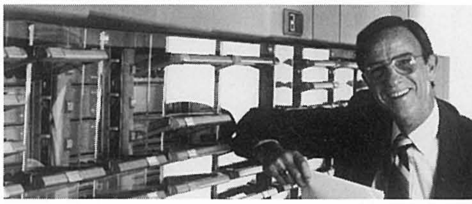
DIRECTOR'S REPORT

Joseph F. Cashen
Executive Director,
The Computer Museum



As the only museum in the world solely committed to computers and their impact on society, we have before us extraordinary opportunities and an audience with both national and international dimensions.

Fundamental to our mission is the preservation and celebration of the history of this remarkable and dynamic field, and the exciting and educating of all levels of the public about computing and its impact on their lives.

The Museum has what is unquestionably the best collection of post-1950 computers and robots in the world. Rather than just storing the collection for preservation purposes, we leverage it by utilizing key artifacts in exhibits to help us implement the other parts of our mission. An example is our Smart Machines Theater which presents our unique robotic artifacts with an explanatory light/video show that is both entertaining and educational for many levels of visitors. Our national impact is being increased by such activities as *Computers in Your Pocket*, a travelling collection-based exhibit currently on a 16-city tour across the country, our CDC 1604 on display at Cray in Minnesota and our Univac 1 being exhibited at the Computer Science Conference in Louisville.

More than 60 computer-based, interactive stations provide more interesting and educational opportunities for our visitors. Our longer term exhibits are complemented by time-sequenced temporary ones such as the SPOT exhibit which vividly demonstrates how digital satellite imagery helps humanity deal with natural resource utilization. The computer processed satellite images are also highly prized for their artistic beauty.

Although we have a separate Education department, our education mission permeates all our exhibits and programs; our responsibility as an informal learning center for computing is woven into all our activities. Our various outreach programs have been well received and we are committed to building this activity even more in the months and years ahead as a way of improving our rapport with young people in particular. Nurturing this link to youth is an exciting way the Museum can help the great numbers of people who have no knowledge of computers at all or who are intimidated by them.

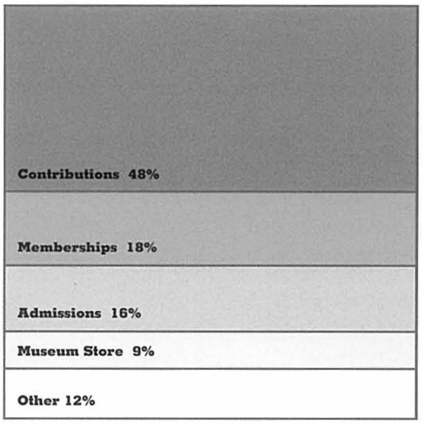
Given our ambitious role and our limited resources, the need for good, committed staff people is particularly obvious. With the addition of our new senior Education Director and other key new people, our staff is capable of addressing the challenges in the months and years ahead. The "Year in Review" section of this report hopefully gives you a feeling for the pace and vitality of the Museum, and the accomplishments of the staff. It also points out the increase in our national impact through such activities as our first travelling exhibit and the highly successful, exciting inauguration of The Computer Bowl.

On the subject of national and international impact, it is interesting to note that 50% of our visitors are from outside of Massachusetts and about 12% of them are from foreign countries.

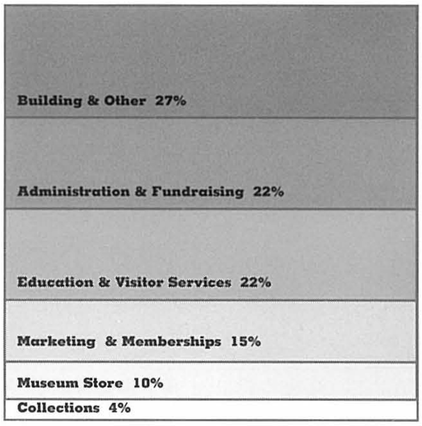
A common question from people interested in the Museum involves where our funding comes from and how it is used. Audited financial statements are available for those interested. The charts below graphically depict the flow of our Operating Budget. Note that the Operating Budget does not include new exhibit development costs. New exhibits are all self-funded in that the dollars needed are raised on a per-exhibit basis. The Museum is primarily funded by private contributions and memberships. The Commonwealth of Massachusetts supplies some funding for reduced admissions, but very little support comes from government agencies.

I sincerely hope this Annual gives you a more complete understanding of what The Computer Museum is about. We believe every Museum visitor gets a better understanding of the computer revolution and its impact on society. With your continued interest and support, The Computer Museum will implement its critical mission even more effectively and grow into the world-class institution we all want it to be.

Fiscal year 1988 operating revenue



Fiscal year 1988 operating expenses



The Year in Review

This banner year began with the signing of a historic joint collecting agreement with the Smithonian Institution and culminated in the world's first Computer Bowl, a nationally televised event benefitting our educational programs. The Museum launched its first traveling exhibit and its first internationalcomputer graphics research project. *How Tall Are You?* became our first outdoor exhibit. A children's robot-building workshop encouraged youngsters' hands-on involvement.

1987

Museum signs historic joint collecting agreement with Smithsonian Institution.

October 7
Charles E. Sporck, President & CEO, National Semiconductor Corp. Breakfast Seminar: ***Sematech: Why Manufacturing is Important.***

October 11
Marvin Minsky, MIT: ***The Society of the Mind: A Psychological Look at Artificial Intelligence.***

October 18
J. W. Forrester, MIT, Robert R. Everett, The MITRE Corporation, and C. Robert Wieser, Science Applications International Corporation: ***Whirlwind's Genesis and Descendants.***

November 1
Hans Moravec, Carnegie-Mellon University: ***Robots: A Recapitulation of Life.***

November 5
Joseph T. Brophy, Senior Vice President, The Travelers Companies. Breakfast Seminar: ***Linking the Knowledge Workforce.***

November 6-8
25th Anniversary of Computer Games features representative exhibits and symposia on past, present and future games.
Gala party for *Spacewar!* inventors.
2nd International Core Wars Tournament and teach-in.
Demonstration of world champion MITEE Mouse robot.

1988

December 3
William F. Zachmann, Senior Vice President, International Data Corporation. Breakfast Seminar: ***The Second Era of Information Technology: The 1990s ...and Beyond.***

January
Education Department takes lessons in robots and computer literacy to New England classrooms.

January 14
Naomi O. Seligman, Senior Vice President, The Research Board. Breakfast Seminar: ***Roots and Rhythms of the Future: Compelling Technologies.***

January 28
Jon D. Miller, Director of the Public Opinion Laboratory, Northern Illinois University. Breakfast Seminar: ***The Future of Scientific Literacy.***

February
Compare the Candidates program allows visitors to contrast presidential candidates' views.

February 4-6
Alice Trexler, Tufts University, introduces computer-assisted dance.

February 7
Ken Knowlton, Wang Laboratories: ***Experiments in Computer Graphics and Art.***

February 20-21
Third Annual ***Kids Computer Fair*** introduces educational and entertaining software via special interactive exhibits, resource center, and robot playpen.

February 28
Stephen Ocko and Mitchell Resnick, Media Lab, MIT: ***LEGO/Logo: Building a New World in the Classroom.***

March 6
Peter Oppenheimer, The Computer Graphics Laboratory, New York Institute of Technology: ***Beyond Nature: Computer Graphic Simulations of Life.***

March 13
Ray Kurzweil, The Kurzweil Foundation: ***Intelligent Machines of Today and Tomorrow.***

March 18
Max D. Hopper, Senior Vice President, Information Systems, American Airlines. Breakfast Seminar: ***Strategic Uses of Technology: Benefits and Pitfalls.***

March 19-20, 26-27
SIGGRAPH Electronic Theater

April
As part of Boston's Museum Goers Month, ***Awesome Adventures*** introduces interactive exhibit of maze exploration, flight simulation and 3-D animation.

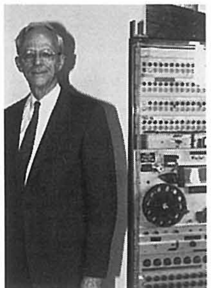
April
By Kids' Design exhibit features winners of national computer creativity contest for students and teachers.

May 5
First teachers' workshop, supported by Massachusetts Council on the Arts and Humanities.

May 1
Dennis Ritchie, AT&T Bell Labs: ***Unix: A Dialectic.***

May 8
David Zeltzer, Media Lab, MIT: *Interacting* ***with Animated Microworlds.***

Jay Forrester at the Whirlwind reunion.



The opening of ***The Interactive Image.***

Ray Kurzweil: lecture and demonstration.

We opened a host of new exhibits while continuing to draw computer pioneers, innovators and industry leaders from around the world to meet, share, and contribute. The events of this successful year are a tangible expression of our mission — to educate people of all ages; to preserve, promote and celebrate computing; and to be a resource for the international community.

May 9
Institute of Electrical and Electronics Engineers, Inc., honors Board Member Robert M. Metcalfe. He donates $10,000 award to Museum.

May 12
Stuart Wecker, President, Interface Design, Inc. Breakfast Seminar: ***Computer Networks: Myths, Reality, and the Future.***

May 15
Tod Machover, Media Lab, MIT: ***Valis: A New Computer Opera.***

June 17
Gardner Hendrie elected Chairman of the Board.

June 17
Ralph E. Gomory, Senior Vice President for Science and Technology, IBM. Breakfast Seminar: ***Trends in Computing.***

July 2-4
The Computer Animation VideoFest

July 13
Pilot PC Resource Center opens, supported by ComputerLand Corporation, Apple Computer, Computer Arts Resource of Brookline, and Radio Shack Computer Centers.

July 14
Celtics' great Dave Cowens opens new outdoor ***How Tall Are You?*** exhibit.

August
How Fast Are Computers? updates CRAY exhibition of supercomputers.

Milestones: The History of Computer Graphics project starts, supported by ACM SIGGRAPH.

Massachusetts Council on the Arts and Humanities grant funds admissions for students from low and middle income communities.

August 15-November 15
Imagine: Art With the Macintosh exhibition features dazzling full color art.

August 1
Computers in education expert Adeline Naiman becomes Director of Education.

August 27
First traveling exhibition ***Computers in Your Pocket*** opens at the Science Museum, Richmond. Circulated by the Smithsonian Institution Traveling Exhibition Service; funded by Hewlett-Packard.

September
Award for collections conservation study made by the Institute of Museum Services.

September 7
Henry J. Crouse, President, Open Software Foundation. Breakfast Seminar: ***Open Software Foundation's Contribution to the Computer Industry.***

October 7
The Computer Museum launches the world's first Computer Bowl. The East Coast team emerges the winner.

October 14
Max Toy, President, Commodore Business Machines. Breakfast Seminar: ***Personal Computing—Yesterday, Today, and Tomorrow.***

October 30
Robert Abel, Odyssey Filmakers: ***The New Age of Computers: Life in the Hypermedia Fast Lane.***

November
Can Computers Understand English? shows public how computers can begin to understand English.

November 6
Thomas A. DeFanti, Electronic Visualization Laboratory, University of Illinois: ***Computer Graphics And Beyond: The Viewer As Participant.***

November 6
The Interactive Image adds six state-of-the-art graphics workstations to the Image Gallery.

November 9
David L. Nelson, President, Confluent Systems. Breakfast Seminar: ***Technology Trends in the 90s.***

November 29
Terra Firma in Focus: The Art and Science of Digital Satellite Imagery **opens,** supported by SPOT Image Corporation, The Analytic Sciences Corporation, and Digital Equipment Corporation.

December 1
Edward Feigenbaum, Professor of Computer Science, Stanford University. Breakfast Seminar: ***Expert Systems: Industrial and Commercial Successes of the First Wave.***

December 26
First robot-building workshop.

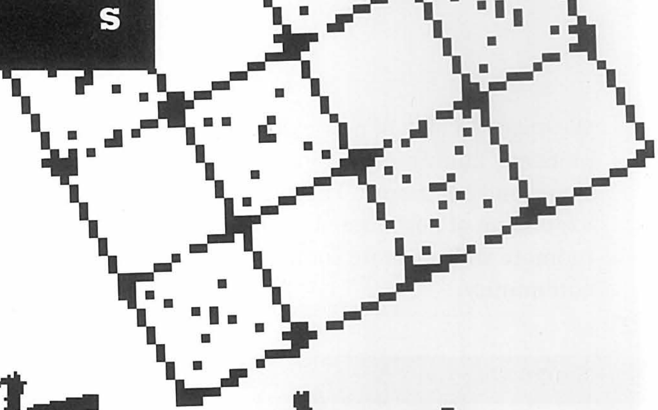
December 26-31
The Computer as an Artist's Tool educational program features Boston artists working in their media to create dramatic new images.

*Dave Cowens opens **How Tall Are You?***

*The opening of **Computers in Your Pocket** at the Science Museum, Richmond, Virginia.*

Computer Bowl wizard Mitchell Kapor.

Robot-building workshop for students.



The Computer Bowl

By now, everyone has heard about the world's first Computer Bowl — described by the media, audiences, and sponsors alike as "the best event of the year in the computer industry." And by now, everyone knows that despite tough competition from the West Coast, the East Coast team was victorious !

But does everyone know that the big winner was The Computer Museum and the winning team was the many sponsors and volunteers who made this event possible ?

A major event doesn't just happen. It begins with a vision which takes shape as a plan that becomes a reality through the efforts, energies and commitment of many people.

The "vision" that became The Computer Bowl began in 1988 with 800 computer-related questions brought to founding President Gwen Bell. The questions were the brainchild of Steve Coit, a partner of Merrill, Pickard, Anderson & Eyre, a West Coast-based venture capital firm. Recognizing that they had the makings of an extraordinary fundraising vehicle, they set to work. Gwen Bell recruited Steve Coit and Technology Research Group president Andy Rappaport as co-chairmen, and hired Boston event marketing and sponsorship consultant Janice Del Sesto.

The next task was to transform 800 trivia questions into a one-of-a-kind event that would attract media, sponsors, and audience. In so doing, the Museum would raise money for its education programs and increase public awareness of the importance of computer literacy.

Thus, The Computer Bowl was conceived. The event would provide a forum in which industry luminaries would for the first time actually "play out" the legendary East/West Coast rivalry. It would parody sports events, and be packaged to attract sponsors competing for industry "position." It would offer an evening of incomparable fun, excitement, and the chance to rub elbows with industry legends. At the same time it would raise money for The Computer Museum.

A strategy in place, the planning group recruited an event committee comprised of board members, friends, and other Museum supporters. They also called upon the talents of the Museum's Public Relations Committee, a group of seasoned PR professionals who advise the Museum on major events. Even before the first press release was issued, a leak leading to a story in the *San Jose Business Journal* prompted many inquiries. Calls and letters began to pour in from media, potential sponsors and ticket purchasers from around the country.

One was from the PBS award-winning TV program, *The Computer Chronicles* , which agreed to videotape and broadcast the event as a special feature and to manage a satellite feed to the West Coast audience.

Now the recruitment of a West Coast committee and a national chairperson were crucial. The national chairperson was an obvious choice. Except for the title, Pat Collins Nelson was already acting as national chairman. Pat was a full-time volunteer working alongside Jan Del Sesto as the project manager. In addition, she and her husband Dave Nelson, a Museum board member, had become "founders" of The Computer Bowl. Having assured her that the only new responsibility would be adding a title to her signature, Pat signed on. She soon recruited Trish Simeone to give up her summer off and become project coordinator.

Meanwhile Gwen Bell and Steve Coit were at work on the West Coast. They convinced Steve's partner Jim Anderson and his wife Nancy, and Kleiner, Perkins, Caufield and Byers' John Doerr and his wife Ann to co-chair a West Coast Committee. The bi-coastal event now had the necessary bi-coastal committees!

Coordination of more than 100 volunteers and contracted personnel became a balancing act. The Museum staff had to balance the requirements of their daily jobs with the additional efforts an event of this magnitude requires. Fortunately, technology helped here. A Xerox-donated facsimile machine and the use of speaker phones made "real time" bi-coastal meetings and immediate responses to press inquiries possible.

Media from around the globe called every day with questions, requests for photos, interviews, and sample Bowl trivia questions. Interviews and photo sessions had to be scheduled, and travel and hotel accommodations had to be made for the celebrities.

There was a game show to produce, a script to write, a set to design and build. Who could the Museum recruit for that? Fortunately, the choices here were obvious: Chris Morgan, a collector of rare computer books and a former editor of *Byte* would select, edit, and write additional questions with Gwen Bell. Lighting designer Alan Symonds and sound man Michael Callahan who had worked on several Museum exhibitions would design and build the set with Tom Merrill and Dan Griscom of the staff.

Meanwhile, using Alan Shapiro's official logo design, the creative studio of Carol Lasky was creating posters, program books, t-shirts, and invitations (the inventive invite produced on a Dysan floppy disk received media acclaim). Tony La Fuente had his crew at Flagraphics busy at work making the banner and flag that would greet everyone at Boston's World Trade Center.

Cash sponsors were signing on after negotiating their "official" status. Trade sponsors came through with much needed services and products. More and more people called wanting to help out, to become a part of that exciting adventure called The Computer Bowl. Eventually, 40 sponsors contributed more than $400,000 in cash, products, and services for this event.

By October 7, the invitations, word-of-mouth, and extraordinary media coverage in industry journals and publications including *The Wall Street Journal, The San Francisco Examiner, Business Week* and *USA Today* spread the excitement. It seemed everyone knew about The Computer Bowl. And judging by the number of phone calls in that last week before the event, they all wanted to come. The Museum had created what was to become the most talked-about, best-covered event of the year (outside of industry product announcements that is!). Several weeks later more than 800,000 TV viewers across the country had the chance to see East and West battle it out when PBS aired the event on *The Computer Chronicles.*

Did the event turn out as expected? Well, not exactly. There were a few surprises. We can thank technology for one. Satellite problems delayed the broadcast for thirty minutes. But even that had its bright side. The East Coast audience was able to hear all of host Chris Morgan's techie jokes. The West Coast audience got to see hosts Gordon Bell, wizard of the tech world, and venture capitalist John Doerr tap dance to the tune of "computer companies I have known and loved!" Bowl watchers on both coasts claimed to have enjoyed the surprise entertainment.

Other surprises? Well, if you ask the West Coast team (David Bunnell, Adele Goldberg, William Joy, Allen Michels and Casey Powell), they'll tell you the biggest surprise was that they didn't win. If you ask the East Coast team (Richard Shaffer, Esther Dyson, David Hathaway, Mitch Kapor and John William Poduska, Sr.) they'll tell you everything went just as they expected.

But the biggest and best surprise of all was that the extraordinary efforts of volunteers, staff, and team members, and the exceptional generosity of businesses and individuals resulted in this event being the most successful in The Computer Museum's history! Press, audiences, and sponsors raved about the Bowl for months afterward. Letters and calls to the Museum expressed praise and thanks for an evening to remember.

And what may come as no surprise at all is that now nobody can wait for the next Computer Bowl in 1990. See you there!

A Ten Year Perspective

Gwen Bell
Founding President

A decade ago, in the winter of 1979, I met with a small group of people at Digital Equipment Corporation to talk about plans for a computer museum. In 1976, Ken Olsen had asked a consultant to write a report on the idea of such an institution. The focus of this report was the education of school children. Concurrently, Jonathan Rotenberg put together his first proposal for a computer discovery center, and a Silicon Valley group started the idea of their high technology center. All of these ideas were ahead of their time, and are only now starting to get off the ground.

Ten years ago, when the plans for The Computer Museum were made, they reflected the environment of the time. The mainstream of computing was time-shared minis and batch-processed mainframes. The Apple II, Commodore Pet, and TRS-80 were a year old and considered to be "hobbyist" computers. Dan Bricklin was dreaming up the first spread sheet to be sold to mini-computer users along Route128. Few people foresaw the spectacular personal computer revolution that was to come. Few people cared about the early first generation vacuum tube computers that were being thrown out.

It was easy to start The Computer Museum by collecting old machines, film, and video and doing some "oral video" of the pioneers of computing, who, with a few exceptions, were alive and well. Even Release 1.0 of The Computer Museum was more than hardware boxes sitting out on the floor. What changes a collection into a museum is the human interface, the software interpretation that allows people to appreciate and learn from the exhibits. In Release 1.0, these were mainly signs and photographs that helped to interpret the early machines in their context. Like many first releases, the human interface was hardly easy to use. The oldtimers, who remembered programming in assembly language and hand-soldering machines, loved these exhibits. In fact, one said to me, "Why isn't the Museum in Boston, like the first one in Marlboro?" This is a minority opinion, the first exhibits were inexplicable to most people and did not begin to meet any public need for explaining computers.

In the eighties, a rapid change started to occur in the industry. Within three years, the PC was announced with word processing, spreadsheets, and enough memory to make it a business and educational tool. This revolution, along with a move to Boston, allowed the Museum to take on a new look and feel.

In the fall of 1984, Release 2.0 of The Computer Museum opened at the present site. Many of the old machines were put away in the warehouse. Only the most dramatic and special computers were put on display in a context with more information than Release 1.0, but at a level best understood by engineers. Guided tours with trained interpreters from the Museum staff help make these exhibits understandable to school groups and other visitors. One-third of Release 2.0 used interactive computer stations where even the unknowledgable could have fun experimenting with personal computers and investigating graphics applications.

It became clear that the interactive element — computer discovery — was what most of the visitors liked, even if they came to see some of the historic machines.

In June 1987, the Museum opened *Smart Machines*, release 2.5, where the visitor explores and investigates the world of artificial intelligence and robots. Human interface in this area is even easier: machines respond to voice and speak back, to physical presence, and with touch. Keyboards are only one small part of this interface and signage is supplemented by video, sound, and dramatic displays.

Release 3.0, the future museum, may finally be able to realize the dreams of ten years ago to communicate the excitement of computing to a broad audience. An unparalleled collection will continue to be used to develop unique and exciting historical exhibits. The tools of new easy-to-use computers will be used to define a new level of interactivity in Museums. For the first time, using interactive video, exhibits can have layered messages that will appeal to different levels and interest groups. The evolution of the computer — that we celebrate — will also transform this Museum into a new multi-level, multi-layered experience that can grab every family member from a six-year old to a PhD in Computer Science and to a grandmother intimidated by the new world of computing surrounding her.

In all of this the Museum proceeds step-by-step, experimenting with the new while preserving the old. The vision leads to Release 4.0, reflecting the new advances that are still in the realm of "computer imagineware." Come along this road with us. Help the Museum preserve a distinguished past and bring the newest computing concepts to the public.

A Plan for the Museum's Exhibits

Oliver Strimpel
Curator & Associate Director

The Computer Museum Exhibits Committee

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The Computer Museum Staff

Oliver Strimpel
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Adeline Naiman

The Computer Museum's mission is, in part, to educate and inspire all ages and levels of the public through dynamic exhibitions and programs on the technology, applications and impact of computers.

Over the past year, The Computer Museum's Exhibits Committee has debated the future of the Museum's exhibits. What exhibits should characterize Release 3.0 of The Computer Museum? The first step towards answering this question has been taken — the Committee has produced a long-range plan for the Museum's exhibits. This article presents the essence of that plan.

The Purpose of the exhibits

Exhibits provide an environment for "landmark learning," the grasping of key ideas in a new subject. Exhibition galleries filled with an engaging array of interactive displays, original artifacts, and video have a special power to inspire visitors to make mental leaps into new fields. The selection of content and media serves the educational goals of the Museum.

What are the educational goals of the Museum? They are to stimulate the general public's curiosity about computers; to address their fears and misconceptions; to evoke an interest in computing that could profoundly affect the course of a visitor's life, especially among the young; and to reveal how computers work, what they do, and the role they play in society — past, present, and future. The Museum's educational thrust is described more fully in the article on page 12.

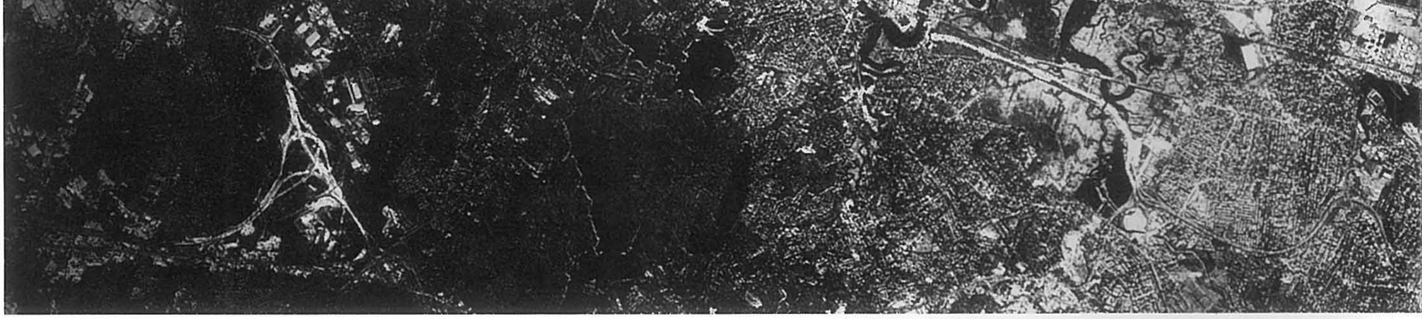
Communicating with visitors

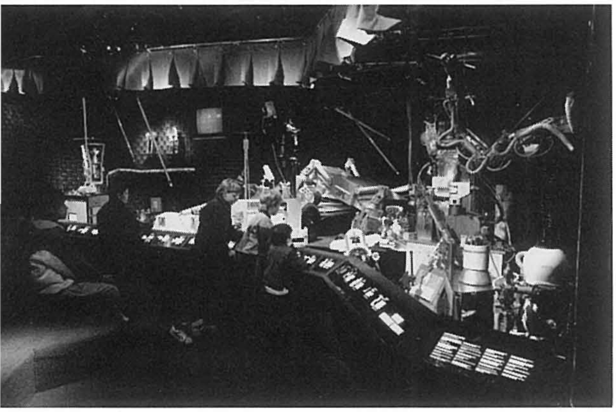
The Museum attracts visitors of all ages and diverse backgrounds. Forty percent are children, and the majority of the adults do not know much about computing. A significant minority are computer professionals. Over half the visitors come from outside Massachusetts, and over 10% come from abroad. The Museum's exhibits must strive to open new horizons for all its visitors.

An important tactic for accomplishing this will be to plan diverse exhibits that offer great variety as the Museum is traversed. Individual exhibits may appeal to particular visistors more than others, but the overall mix at the Museum will offer a rewarding experience for all.

Two exhibit types can have particular impact on visitors. The first is the "larger-than-life" display, epitomized by the walk-through human heart in the Chicago Museum of Science and Industry, or the "Soup Machine" animated computer of the National Museum of Science and Technology, Ottawa. Such exhibits envelop visitors with a revealing new perspective on the museum's subject matter. They instill a powerful take-home impression that is a salient characteristic of many successful museums. The Computer Museum's new galleries will include two such exhibits: a recreation of a giant 1950s computer room and the Walk-Through Personal Computer.

The second highly effective type of display is the hands-on interactive exhibit where visitors learn by doing something themselves. This stimulates a depth of understanding not attainable through passive watching or listening. The Museum currently has over 60 interactive, computer-based exhibits; over the next few years, this number will approach 100. In addition to offering fresh experiences, this increase will ease crowding, allowing a greater proportion of visitors access to the interactive exhibits of their choice.





Smart Machines

Opened in June 1987, Smart Machines *explores artificial intelligence and robotics with many interactive exhibits, including expert systems, natural-language-based systems, robot sensing demonstrations, and a theater with a multimedia show, that features the classic robots. The 3,750 square foot gallery cost $500,000 to develop, with an equal match of in-kind donations of hardware, software, and labor. It is the Museum's most popular exhibition.*

Exhibit content

Each of the Museum's exhibits will address one or more of the following topics: computer applications and the social impact of computing, how computers work, evolution of computing, and people in computing. Many exhibits will contain a richly interwoven mixture of all these areas.

Computer Applications and Social Impact

This topic has wide appeal because people want to discover what computers are capable of doing and learn how they will affect their lives. The Museum is a natural place in which to demonstrate computer applications; visitors can engage with them directly, gaining an experience that cannot be matched by print or audiovisual media.

The two most popular major galleries in the Museum, constituting over a third of the current exhibit space, focus primarily on computer applications: *Smart Machines*, featuring artificial intelligence and robotics, and *The Computer and the Image*, showing image processing and computer graphics.

The Museum will radically expand the scope and range of computer applications presented, starting with a major exhibit on personal computers. This will demonstrate key application areas and will offer visitors many hands-on interactive computers for experimentation and play.

Another exhibit featuring applications and their social impact will be *The Networked Society*. This will present large-scale computer applications that control information essential to the running of modern society. Examples will include telephone networks, airline reservations, on-line banking, international finance, manufacturing, and retail networks.

How Computers Work

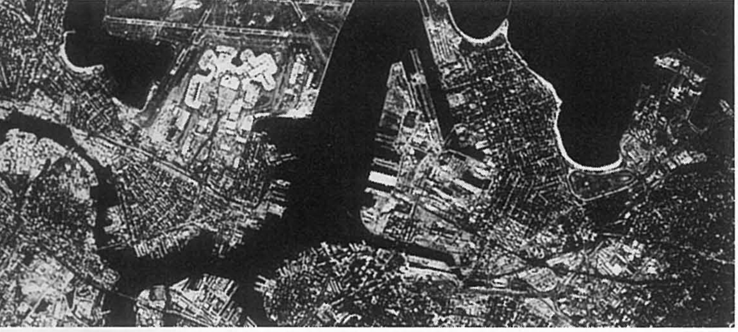
The centerpiece in this area will be a giant walk-through personal computer. Visitors will roam through this gallery-sized simulation of the inside of a working computer, discovering what the main parts of the machine are and how information flows between them. Visitors will be able to interact with this "computer" by means of giant input devices and see their data or instructions travel to the processor and memory, be manipulated, and sent to an output device. This larger-than-life exhibit will create an indelible impression for visitors and may become the Museum's hallmark.

Topics that will be adressed in other exhibits include miniaturization, the difference between hardware and software, and the nature of a program. Special care will be required to make these exhibits truly accessible to visitors with little computer knowledge, while serving the intellectual needs of experts.

The Evolution of Computers

The Museum plans to develop two permanent historical exhibits. *Milestones of Computer Evolution* will present the key innovations in the history of computer hardware, software, and applications. The exhibition will feature the social factors that stimulated the development of computing, and, in turn, the effect of computers on society. *Milestones* will define a basic level of computer history literacy for schoolchildren and the general public.

The second exhibit will feature the world's largest computer — a SAGE system from the U.S. Airforce's early warning line, active from the late 1950s until 1983. The display will combine the Museum's SAGE artifacts with audiovisual and special effects to create a dramatic reconstruction of an early computer environment.



Terra Firma in Focus
The Art and Science of Digital Satellite Imagery
The Computer Museum's most popular temporary exhibit of the year displays spectacular imagery from SPOT, the French remote-sensing satellite. The displays demonstrate how, with the help of computers, satellite images can provide valuable information for agriculture, natural-resource exploration, map making, and news gathering.

In addition, many other aspects of computer evolution will be covered as introductory or background sections within other thematic exhibits, both permanent and temporary. The history of personal computers, for example, may be presented within a thematic gallery on personal computing.

Visitors who wish to see artifacts from the Museum's collection that have not been selected for public display will be able to tour the Museum's Visible Storage area. There they will see all the significant artifacts in the collection, labeled with general descriptions and detailed specifications.

People in Computing

The achievements of individual computer engineers and entrepreneurs provide a good vehicle for focusing on specific technologies, applications, and their social impact. Temporary exhibits will be mounted to feature specific groups of individuals, perhaps on the occasion of important anniversaries. Audiovisual programs showing computer innovators will be used wherever appropriate to add a human dimension to the exhibits.

Serving the national and international public

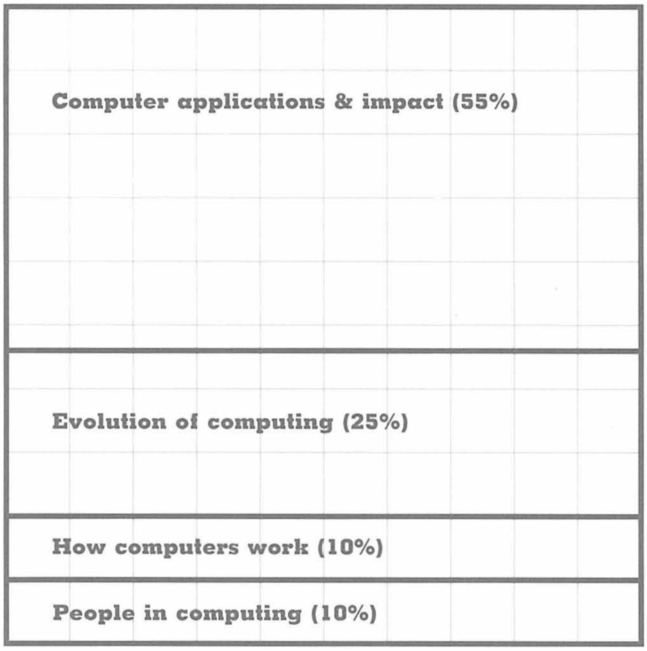
In many parts of the world there is a crying need for resources that can stimulate the growth of computer literacy. The Computer Museum has the world's most extensive set of exhibits on computing. We plan to maximize their educational impact by sharing them with a broad public in other parts of the country and abroad. The Museum is pursuing two approaches to meet this need.

First, the Museum will create exhibits that tour science and technology centers under the auspices of the Smithsonian Institution Traveling Exhibition Service (SITES) or the Association of Science-Technology Centers. *Computers in Your Pocket* is the first such Computer Museum exhibit, currently being toured by SITES.

Second, the Museum plans to distribute exhibit kits that provide the materials and information required to replicate Computer Museum interactive exhibits. Exhibit kits would be sold at reasonable prices to science and technology centers around the world, saving needless reinvention and bringing the benefit of The Computer Museum's experience to tens of millions of museum and science center visitors each year.

The Museum currently has 19,000 square feet (almost half an acre) of public exhibit space, with a further 9,000 square feet available within the building. Over the next four years, over half the existing exhibit space will be redesigned from scratch, and a new 2,500 square foot bay will be opened.

Proposed allocation of exhibit space
(proportional)



The Living Classroom

Adeline Naiman
Director of Education, The Computer Museum

The forms of education have been changing as rapidly as society itself in recent years. The proliferation of information has made this the age of the specialist. No brand of conventional schooling can prepare students adequately to meet an indefinable future, yet this is what schools today are expected to do. No wonder they are charged with failure.

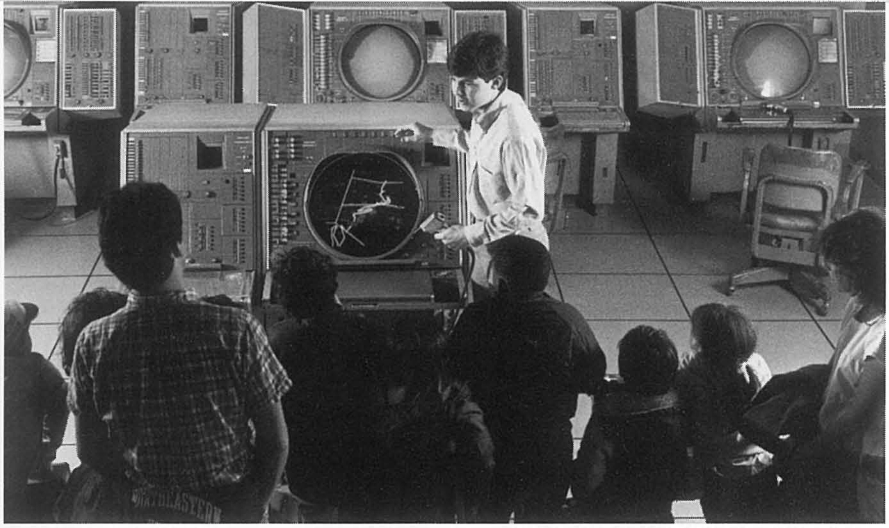
Still, we humans are remarkably resilient—and entrepreneurial. In the past couple of decades, "continuing education" or "lifelong learning" has helped restore educational possibility to those who missed it first time around or who want to better their lives.

More recently, the notion of "informal education" has come to the fore. Its underlying assumption is that people must take charge of their own learning and not simply receive it whole as packaged and directed instruction. Museums are ideal places for informal learning. This does not mean that we abandon the responsibility for presenting knowledge and throw the whole smorgasbord out on the table for visitors to sample heedlessly. No indeed; the recognition that people of all ages come to a museum to explore, enjoy themselves, and find answers to their questions puts an even greater reponsibility on museum staff to set the table carefully and selectively, to make the array appetizing, and to frame the setting to satisfy explicit and hidden hungers. We must shape the learning environment with greater care than a classroom or textbook can, because we cannot simply "teach"; we have to capture and satisfy our learners.

Of course, the mission of every museum is, in part, to educate—to preach to the unconverted. The Computer Museum stands in a special relation to that mission because the technology that constitutes our collections, exhibits, and programs is a scant half-century old, and while our members and supporters are well informed about computers, most of the public is not. Indeed, what brings a great many of our visitors to the Museum is their curiosity to find out about this dazzling new technology, see it in action, and try it for themselves. The Museum's exhibits are increasingly designed to meet their needs.

The Computer Museum's Education Department builds on this desire for knowledge in several ways. One way is to work with the staff to help them match their tours and presentations to the requirements of visitors of a range of ages, background understanding, hands-on experience, and interests. We make a special effort to reach young people from school, camp, and community groups. We have a particular goal of bringing inner-city children to the Museum and helping them recognize it as theirs. We reach out to elderly visitors and to people who are physically limited. Always, we strive to maintain gender equity in our programs and materials; the computer is, after all, neuter.

Other ways we support such efforts is to design, refine, and present new demonstrations on topics of general or school interest and to incorporate these into the regular visitor schedule. To the extent possible, we also offer presentations to groups outside the Museum. By collaborating on exhibit development, we try to add an explicitly educational perspective to the design and communication aspects of exhibits.



All student groups receive a guided tour of the historical galleries. Here, an MI explains the SAGE Blue Room.

Future educational services

A long-term goal is to expand the educational services we provide to people who call or write in for specific information, resources, or other help. Our newly revised and reprinted Educational Activities Kit serves as a brief introduction to computers. It is routinely given to all school tour leaders, so that they may prepare students for the Museum visit and follow it up with classroom activities. Following reviews in national media, orders are coming in from all over the country. We expect to add toour existing printed handouts and workshops and to develop new resources—videotapes and descriptive sheets about the Museum's collections and exhibits, focused publications, topical teaching guides.

We plan to create within the Museum a teacher resource center, where we will offer presentations, workshops, and short-term courses. Here we expect to have the latest and best available hardware and software designed to bring the classroom and curriculum up-to-date. Teachers will be able to try out equipment and courseware they might not otherwise have an opportunity to explore for themselves. Students and their parents will be helped to use innovative teaching materials, and all visitors will be welcome to test the cutting edge of educational technology.

The center will have educational software, books, and periodicals, as well as videodisks, CD-ROM disks, audiocassettes, and videotapes, all with players. It will have printers and a local-area network with server and software. We already have a start on telecommunications equipment with subsidized connect time to a number of databases. We are looking to commercial sources to fund and equip the Center and help us staff it. It is our hope that teachers and school administrators will come to regard this as their special place within the Museum.

Steps we're taking right now

Meanwhile, we are expanding free or reduced-admission visits for low-income schools with the help of increased funding from the Massachusetts Council on the Arts and Humanities. In early October, we sent a new tour guide to schools and community groups within comfortable visiting range of Boston, and we continue to host groups from the New England states and even beyond. Each tour begins with a survey of the great computers on exhibit and allows time for free exploration of our interactive exhibits. Visiting teachers report considerable satisfaction. Repeat visits are common.

During school vacations and on weekends and holidays, we offer special events. This December vacation week featured demonstrations by computer artists-in-residence. A successful first was the "Build Your Own Robot" workshop for child-adult pairs. This will be repeated on coming holidays.

February vacation week culminates in Kids Computer Fair, which brings commercial vendors to the Museum and allows children and their parents to sample the latest software. Special Needs Day and October Computer Learning Month offer additional opportunities for participatory learning.

Off-site presentations have been much in demand and serve a valuable function in bringing the Museum to audiences that might not otherwise come here. Only a shortage of staff limits the number of requests we can meet, and we are seeking foundation support to expand our outreach activities.

These and many other activities have been carried out by our small education staff. During the summer, Michael Chertok, Education Coordinator, set up a pilot Computer Resource Center with borrowed equipment, and staffed it with Boston high school students. Visitors were able to try out personal computers, application software, and a telecommunications network. These hands-on activities were especially appealing to school-age visitors, including those who came on tours from summer camps. They also proved engaging to adults eager to get their hands on new equipment and software.

I joined the Education Department in August, 1988. Building on the Museum's existing strengths, and in collaboration with the staff of the other Museum departments, I am confident that we will fulfill our collective mission to make The Computer Museum a significant force in the education of a wide public and help to create a technology-literate citizenry.

Computers and Scientific Literacy

Jon D. Miller

Professor Miller, Director of the Public Opinion Laboratory, University of Northern Illinois, has been measuring scientific literacy for more than a decade. The Laboratory is currently undertaking the Longitudinal Study of American Youth with support from the National Science Foundation. Three thousand seventh- and tenth-grade students will be followed for four years. Their teachers and parents will also be interviewed. The following article is based on preliminary results concerning the level of scientific literacy of tenth-grade students, and the impact of computer awareness on scientific literacy.

Basic scientific literacy refers to the ability to read and write about scientific topics. Functional scientific literacy allows a citizen to understand major public policy issues involving technological issues.

Basic scientific literacy demands a vocabulary and an understanding of the process of science. To test concept comprehension, people have been asked to rate their own understanding of terms like radiation, DNA, and computer software. To test understanding of the process of science, people have been asked to explain in their own words "what it means to study something scientifically."

Technological literacy concerns the understanding of the impact of science on society and vice versa. National samples of adults have been asked to describe the advantages and disadvantages of events like the construction of a nuclear power station in their local area, efforts to communicate with other intelligent life in the universe, or the additives to their foods.

These three substantive dimensions are functional scientific literacy. These concepts are important in thinking about science and technology and should influence the selection of strategies for public communication on issues.

Distribution of functional scientific literacy

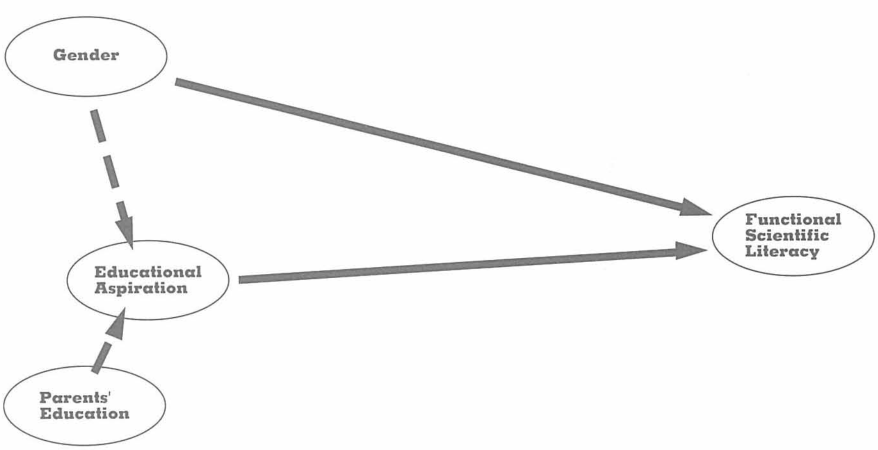
The Longitudinal Study of American Youth found that 81 per cent of high school sophomores failed to qualify as either scientifically or technologically literate. The student's gender, educational aspirations, and parent's education skew this distribution. Table 1.

To assess the relative important of gender, educational aspiration and parental education, a log-linear path model was constructed. This model, Figure 1, shows that educational aspiration and gender are directly related to functional scientific literacy and that parental education exercises influence only through the level of educational aspiration. The data suggest that better-educated females tend to share their own interest in science and technology with their children and to stimulate the early acquisition of functional scientific literacy.

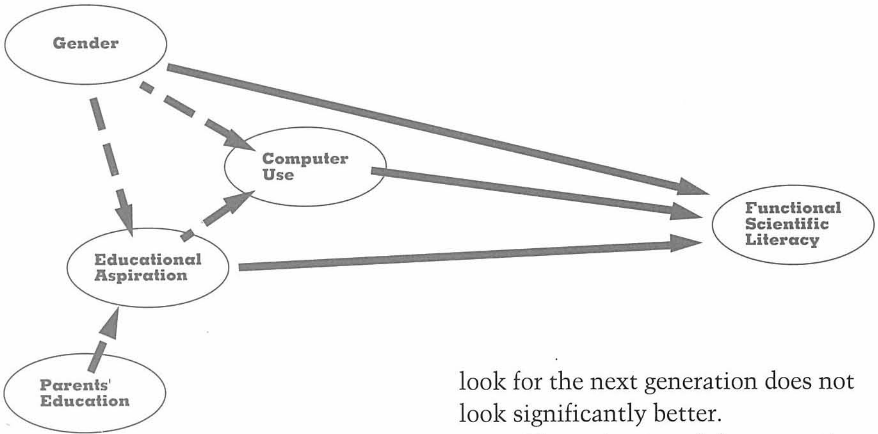
The Distribution of Functional Scientific Literacy among High School Sophomores by Gender, Educational Aspiration, and Parents' Education. 1987.

Parents' Education	Educational Aspiration	Boys %		Girls %	
High School or less	Less than college	**1**	(171)	**2**	(163)
	Baccalaureate	**11**	(70)	**1**	(56)
	Graduate degree	**30**	(20)	**0**	(57)
Some college	Less than college	**4**	(87)	**1**	(79)
	Baccalaureate	**13**	(41)	**3**	(71)
	Graduate degree	**21**	(41)	9	(54)
Baccalaureate	Less than college	**1**	(36)	**0**	(30)
	Baccalaureate	**11**	(65)	**1**	(58)
	Graduate degree	**21**	(87)	**10**	(98)

A Path Model to Predict Functional Scientific Literacy among High School Sophomores. 1987.



A Path Model to Predict Functional Scientific Literacy among High School Sophomores, including the Influence of Computer Use. 1987.



The impact of computer use

Students were asked whether or not they used a computer 10 or more hours during the preceding summer. This is a useful measure because summer use would most likely be voluntary — as opposed to a classroom requirement. Seventeen percent of high school sophomores reported that they had used a computer more than 10 hours.

This variable was placed in the path model of family education level, gender roles, and educational aspirations. Computer use was found to have a direct and significant positive relationship with functional scientific literacy. (Figure 2)

The level of summer computer use is influenced by the level of educational aspiration and gender. The influence of parental education appears to be limited to fostering educational aspirations with no residual effect on summer computer use or functional scientific literacy. The level of educational aspiration is the strongest influence on summer computer use, accounting for 53 per cent of the total mutual dependence. In contrast, gender accounted for 16 per cent of the mutual dependence.

How are we to attribute influence? Variables were entered into a stepwise model that we think mirrors reality. Each variable predicts the maximum amount of mutual dependence possible. We reasoned that the level of educational aspiration is a long standing attitude and that computer use is a more proximate variable and should be entered first. If this order is followed, then summer computer use accounts for 22 per cent of the total mutual dependence. Educational aspiration is then entered second and accounts for an additional 36 per cent and gender is entered last, explaining about 17 per cent of the mutual dependence of the model.

What difference does each variable make, holding constant all of the other variables? What is the unique contribution of summer computer use when the level of educational aspiration and the gender of the student are held constant? Using a main effects model, and examining a series of models that systematically delete each variable one at a time, summer computer use accounts for only nine percent of the total mutual dependance.

The discrepancy between the two models tells us that there is a very strong joint effect between the level of educational aspiration and computer use, which is what we might have expected.

Implications

Thinking ahead to the 21st century, it is likely that the number and sophistical of science policy issues on the national political agenda will markedly increase. Many issues, like recombinant DNA processes and products, will require a reasonable level of understanding of modern biology. Other issues, especially those involving risk assessments, will require an understanding of probability. My findings show that present levels of adult scientific literacy could not support a meaningful broad-based political debate on these issues. Unfortunately, the outlook for the next generation does not look significantly better.

The estimates of the proportion of high school sophomores who are functionally scientifically literate indicate ranges from zero to 30 percent for various demographic groupings. The strong skews in functional scientific literacy away from women and the children of less-well-educated families will make participation all the more difficult for many groups that have been historically underrepresented in the political system. This is a recipe for increased alienation in the political system.

The problems of scientific illiteracy are not going to be reversed or even significantly reduced in the next generation with a significant intervention in the education system. Opportunities in informal education, in access to computers and alternative opportunities for youth are extremely important. The political perils of this situation are great. Attention needs to be focussed on this problem so that we can press for major improvements.

Trends in Computing

Ralph E.Gomory
Dr. Gomory is Senior Vice President for Science and Technology at International Business Machines Corporation, Armonk, New York. This article is based on his talk at a luncheon following the Annual Meeting of The Computer Museum, June 17, 1988.

Miniaturization

Every talk on trends in computing includes a discussion of the continuing progress in miniaturization that has brought us in 20 years from one memory bit on a chip to more than a million. It is worthwhile to reflect on how the industry is able to sustain this remarkable progress.

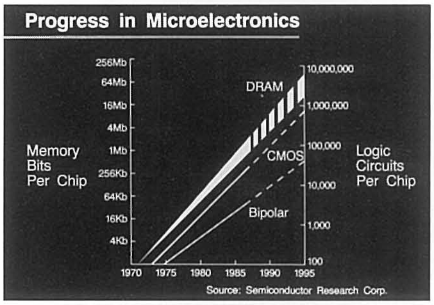
One way of looking at this that tends to confirm the notion of an endless path of improvement is to remember that we don't do any work in this industry. It may not feel that way at times, but computing does not involve physical work. This industry is quite unlike the auto manufacturers, for example, who have to build a car that will carry people up a hill. All that computer products do is move marks around, and we make progress by making these marks (ones and zeros) smaller. There seems to be no limit to this miniaturization, and that, to a large extent, is the game we're in.

The dominant FET (Field Effect Transistor) logic is rapidly moving from one micron toward .35-micron technology and smaller. This inevitable miniaturization process will provide more and more MIPS (Millions of Instructions Per Second) on fewer chips per computer.

The quarter-micron limits that were projected just a few years ago are fading away as they are realized. Tenth-micron technology is working today in the laboratory, and we see no reason to think that can't be improved on. My personal point of view is that even if we should run out of gas in semiconductor technology, we will find other ways to make very small ones and zeros.

Large tools for small circuits

As the circuits get smaller, the tools to make them get bigger. We'll probably, at some point, have to go from optical lithography to something with a shorter wavelength to draw



Source: Semiconductor Research Corp.

Figure 1. Progress in Microelectronics.

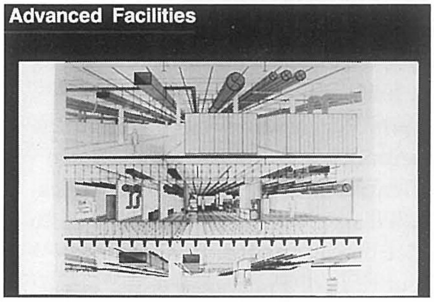
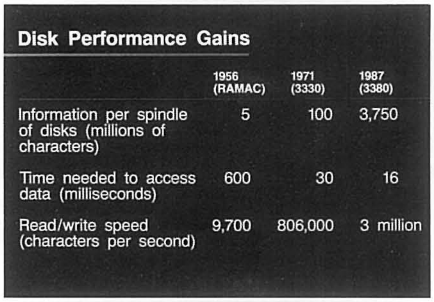


Figure 2. A contemporary three level silicon factory. Only the middle level of the three is used for production. It is isolated for cleanliness and supplied with all the chemicals needed for processing.



Disk Performance Gains

	1956 (RAMAC)	1971 (3330)	1987 (3380)
Information per spindle of disks (millions of characters)	5	100	3,750
Time needed to access data (milliseconds)	600	30	16
Read/write speed (characters per second)	9,700	806,000	3 million

Figure 3. Disk performance gains.

circuits with finer features on the silicon. One of the interesting characteristics of this industry is that if you can make a picture of something, then you can make it. And the finer the picture, the more of them you make.

None of this is cheap; it is just the opposite. To make progress, you have to make things small. To make things small, you need complicated tools. Further, these tools have to operate in a clean environment. The result is that the tools are expensive and the plants are even more expensive. Modern silicon factories can effectively use only one-third of their floor space. The rest is to keep things clean and circulate the processing gases and other chemicals. Such a facility costs about $1000 a square foot.

Packaging the chip

Especially in the highest performance computers, the package, the way one chip is wired to another, is as complicated and challenging as the chips. The cycle time, or interval between successive operations in a large system is about equally divided between the chip, the package and other factors combined. With faster circuitry, better packaging is needed to exploit it.

In low-end machines, the principal packaging consideration is not the speed of the interconnections, but their cost. This cost, measured in pennies per wire or input/output connection is what matters in providing low-cost computers, and there is tremendous progress in this area, too.

Increasing disk densities

While progress in microelectronics seems natural, magnetic disks and disk drives are often thought of as clumsy mechanical components that sooner or later ought to be replaced with some kind of solid state storage so that all those nasty moving parts won't be needed. Yet the disk has stubbornly defined extinction. To me it is one of the most amazing branches of computer technology.

A disk, whether it's in a desktop computer or a big disk farm in a large computing center, is fundamentally the same thing. It is a platter that spins at engine speed, typically 3600 rpm, very much like a phonograph, and represents ones and zeros by little magnetized areas on the surface. Figure 3 shows the dramatic improvement in storage capacity and speed from the time of the RAMAC, the first disk.

The problem in disk technology is to sense the magnetization as the disk rotates. The only way to distinguish one bit from another is to get close to them so that the sensor's field of view is filled by a bit. Unfortunately, there is no way to beam magnetic fields.

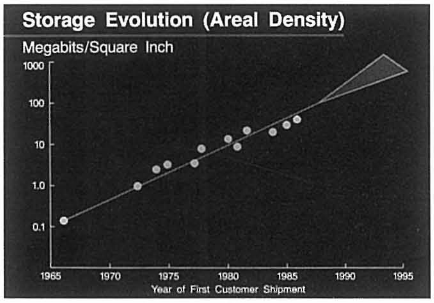
About 1970, the read/write heads in magnetic files were flying between one and two wavelengths of light above the disk surface. And when I use the term flying, they really fly; they are shaped like little airplane wings, and the air holds them up, and springs push them down. Flying one or two wavelengths of light above an imperfectly smooth surface going at 3600 rpm seems improbable. And in the early seventies we thought this was the limit of closeness. No. Today the heads are flying only a third of a wavelength of light — smaller than any dimension in semiconductors — above the still bumpy surface and they are going to keep coming closer to the disk. Because again, progress is made by making the magnetized areas smaller, and that means getting the head closer to the surface.

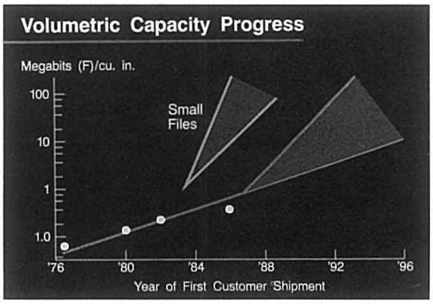
With the advent of desktop computers, the third dimension is becoming more important. Bits per cubic inch is a better measure of how much storage you can put in a small machine than bits per square inch. Progress in getting disks closer together is even more rapid than in packing the bits more densely.

Optical storage is very attractive because light has some nice features. It comes in beams, which allows the head to be moved away from the disk surface. Very small marks can be made with light, and that increases the number of bits per square inch. However, the heads are more complicated, requiring the disks to be spaced farther apart at the expense of cubic density.

The scenario for optical storage started at the write once/read only stage. It is moving toward read/write, relatively low performance products that may march right on up the performance curve.

Figures 4 and 5. The increase in the number of bits stored per square inch of disk surace, and the equally significant progress in reducing the volume of disk storage.





The scanning tunneling microscope

In 1986, two scientists at the IBM Research lab in Zurich were awarded the Nobel Prize for the scanning tunneling microscope. This device, like disks, is a reminder of the power of mechanics. Although mechanics has an old fashioned flavor to it, the notion that the wavelength of solid objects is very short compared to the wavelength of light offers possibilities for very precise measurement. The scanning tunneling microscope is not often looked at as a masterpiece of mechanics, but essentially that's what it is.

The scanning tunneling microscope is basically a tripod with three legs and a little pin that sticks down between them. The mechanics are so good that the little pin can be positioned very close to surfaces. When I say close, I mean 5 or 10 angstroms — one or two atomic diameters. The legs can be extended and contracted with great precision to walk the pin across the surface, scanning it.

The presence of the surface is sensed by putting a voltage on the pin so that some current will tunnel through the gap between the pin and the surface. The wider the gap, the less current flows, so as it marches along, the current varies. This variation maps the heights of the surface at the atomic level.

In Figure 6, each bump is associated with one atom. So in a very real sense, in this picture you are looking at individual atoms. This is different from looking at an x-ray picture of a crystal, where in fact you are looking simultaneously at millions of atoms which, when symmetrically placed, give you a single picture. The scanning tunneling microscope pictures provide views of individual atoms.

In principle, if you can look at atoms one at a time, you can also mark them. This has been done by putting fairly complex molecules on a surface and then, by applying a voltage, changing their state. The pin can be marched away, come back later, and sense the change of state. This is a demonstration of storage created at the molecular level, something I believe we will be doing routinely in the long run.

The human interface

While progress inside the computer is dominated by the paradigm of making things small, the human interface is measured by its ease of use, and we have to do something other than miniaturize it. However, Figure 7 shows that miniaturization helps here, too, because it provides more power for processing new forms of input.

The traditional input methods, hammering on a keyboard or moving a mouse, don't take a lot of processing power. But an easier to use scanner takes more, and handwriting and speech recognition even more. Indeed, speech recognition and eventually machine vision will only become practical because of cheap MIPS that can be devoted to them.

When I joined IBM, 1200 of us shared one 704 computer. If we had decided to devote that 704 to word processing, it could have been fairly successful for one person. Believe me, the thought never crossed our minds. Similarily, what a profusion of MIPS can do is something that is often hard to forecast until they become so cheap that people start to fiddle with them.

Speech recognition is clearly benefiting from cheap processing power. At IBM Research, we have PCs with one or two special cards that will recognize 20,000 spoken words. I don't mean words that run together; you .. have .. to .. pause .. between .. each .. word. With very high speed chips devoted to recognition, this is affordable and will continuously improve.

The great mystery about speech recognition has been the problem of finding a useful application. As the capability has steadily improved year by year, the number of actual uses has remained very low. The goal of dictation to a machine remains elusive.

I don't know how many people want an electronic book, but it's coming and it will be made by sticking together the pieces of technology I have talked about. My model electronic book contains one of those small, very dense disks coming in a few years that will store approximately 300 novels. It has a flat display, a technology which is evolving from the bottom up. That is, it's the same liquid crystal display that originated in wristwatches and just keeps getting bigger. Liquid crystal displays increased in size to become very small television screens, got larger on portable computers, and are on their way to becoming a major alternative to the familiar cathode ray tube.

The book's display surface will also allow hand-marking and character recognition. In a small corner of its disk it will carry correspondence so you can write and edit your letters. The book will be hinged in the middle. I sometimes think that the most doubtful part of the whole thing is whether we can get the optional leather cover to adhere to the back. But all the rest of the technology is going to be available.

Today, workstations are what people use. With their tremendous computing power they are beginning to present an interface that is more natural than anything we have ever seen, as well as being significant computing engines. Many of the obvious things that people do can be dealt with simultaneously on their mul-

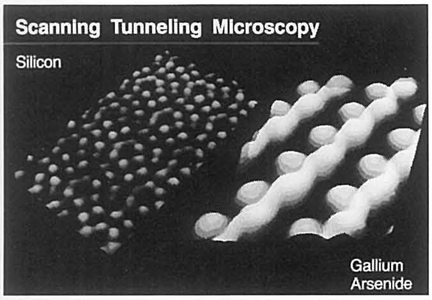


Figure 6. Scanning tunneling microscope images of silicon and gallium arsenide surfaces.

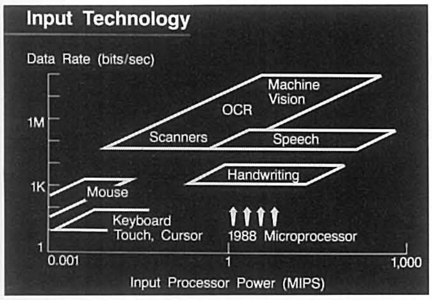


Figure 7. Input Technology.

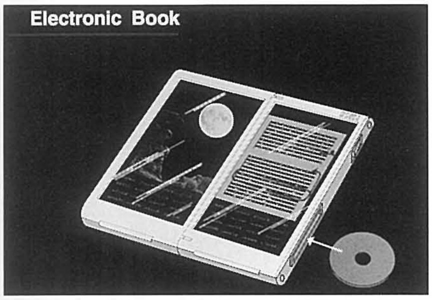
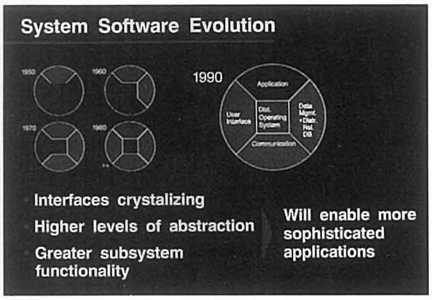


Figure 8. Electronic book



System Software Evolution

- Interfaces crystalizing
- Higher levels of abstraction
- Greater subsystem functionality

Will enable more sophisticated applications

Figure 9. System Software Evolution.

tiple windows. Their power, especially when they are backed up by networks of other computers and with expert systems, will enable users to do very intricate things that will be a mixture of computing and visualizing information.

Software evolution

In 1950, if you wrote an application, you really wrote an application; you wrote it all. Now you tend to write only the part that's unique to the job at hand. The various activities common to many applications have been split off and become subsystems of the system software.

Writing to a tape, for example, gradually turned into a file subsystem, that didn't have to be rewritten for each application. The file system turned into a hierarchical database, then into a relational database, and one day it will become a collection of objects. Similarly over time, other common functions such as communications and independent front-end subsystems are being split off. This means that application programmers can spend their energies on the application, and the system takes over the other functions.

As software evolves, the interfaces between different parts of the system have become cleaner and cleaner. In older operating systems, everything was scrambled together. Modern system software communicates at higher levels of abstraction. For example, in a very modern database (or one just around the corner) you should be able to have a command like "retire" that sets in motion a whole series of changes that reflect an employee's status. The tendencies continue to be: clean up the intrface, deal at a higher level of abstraction, and find greater function in the subsystems.

Software development itself is in rapid transition today thanks to a combination of things: new specification and design tools, languages that enable the use of modules from many different origins, and the ability ot maintain all this, in an orderly way, in a single repository that is accessed by many different tools. Powerful workstations for the programmer are helpful, too, because they allow viewing of work at different levels of detail.

Progress in hardware and software

The technology trends I talked about earlier were not obtained by plotting history on semilog graph paper and drawing a straight line. They were obtained by making the best technological projections about what is possible or what can almost certainly be done. And since they are based on what we already know how to do today, I think most of the surprises will be on the up side.

The growing power in both hardware and software will allow us to move into a tremendously different future. We are only at the beginning. The changes in the next 30 years will be even greater than in the last 30 years, since the time I first used that 704.

The Computer Museum Collections

The collections of the Computer Museum are broken down into three categories: artifacts, film and video, and documentation including photographs.

During the last year, all of the collections (not on loan) were moved to the Museum Wharf site. A 4000 square foot room has been set aside for on-site Visible Storage and to house the archives. A working area will be set up for research. In addition, the Museum has two smaller storage areas where items are kept compactly. The Museum could accommodate the collection in this area because it had arranged with Digital Equipment Corporation to store the Whirlwind and the TX-0, and to loan the CDC 1604 to Cray Research. These objects, alone, would have filled the 4,000 square foot visible storage room. The Museum will continue to make creative arrangements with other organizations to appropriately preserve, exhibit or store other artifacts that we have preserved.

In moving all the artifacts, the collection acquisition's policies were reviewed by the staff and Collections Committee.

Two activities were initiated: a conservation survey funded by the Institute for Museum Services and a project on Milestones in Computer Graphics funded by ACM SIGGRAPH.

The continual refining and development of the collections is made possible with the help of The Collection Committee who meet three times per year. In addition, the group is helpful in providing ongoing advice.

Artifacts

In the last year, 110 artifacts were added to the collection, representing about twenty percent of the offers received. Three large-scale acquisitions were made: the major components of a UNIVAC I, a corner of the CDC 7600 Serial Number 1, and an IBM 3851 "honeycomb" Mass Storage Unit. Representative samples have been taken of a variety of machines, including an IBM 360/40 console front panel, a CDC 39 inch disc, and a SWAC Williams Tube. In some cases, when an object was rejected for the collection, documentation was kept for the "virtual collection."

The Computer Museum Collections Committee

Bruce Eric Brown
Wang Laboratories

Bruce Bruemmer
The Charles Babbage Institute

Joseph F. Cashen
The Computer Museum

I. Bernard Cohen
Professor Emeritus Harvard University

Jon Eklund
The National Museum of American History, The Smithsonian Institution

Gardner Hendrie
Sigma Partners

Christopher Morgan

Jean Sammet
Consultant

The Computer Museum Staff

Gwen Bell

Oliver Strimpel

Allison Stelling

Computers

Computer
Devices Inc.
DOT, 1979
Portable Personal
Computer
*Gift of Mark J.
Lowenstein*
X911.88

Compusource, Inc.
Abacus Personal
Computer, 1984
Portable Personal
Computer
*Gift of
Dr. Kenneth Levites*
X917.88

Control Data
Corporation
CDC 7600 Serial # 1,
see photo p. 26.
*Gift of Lawrence
Livermore National
Laboratory*
X942.88

Convergent
Technology
Workslate Computer,
Briefcase-sized fixed
program Personal
Computer 1985
*Gift of
Allen H. Michels*
X951.88

Data General
Data General One,
Lap Top Personal
Computer 1985
Gift of John Kendall
X908.88

Digital Equipment
Corporation
PDT-11
DEC's first Personal
Computer
Gift of DEC
X860.88

Evans and Sutherland
PS 1, Serial No. 1
Gift of USCD
X943.88

UNIVAC
UNIVAC I
see photo & story
p.22.
*Gift of
Mrs. Sarah I. Lawson*
X941.88

The University of
Illinois Team
PC of the Year 2000,
Prize winning model
1988, *see photograph*
*Gift of the team and
Bartlett W. Mel*
X876.88

Videobrain Computer
Company
Videobrain, 1978
Personal Computer
*Gift of
Charles Backlund*
X874.88

Subassemblies & components

Datanet 760
BCU 7600
Gift of Rob Staples
X921.88

G-2 8-input
Nand/Nor Gate
Decoder for counters
of registers
X959.88

IBM
360-40 Console Front
Panel, c 1968
Gift of Data Sales
X948.88

Infocon
Vista Basic 1
Computer Terminal,
1969
*Gift of
Michael A. Mahoney*
X947.88

Jade Computer
Systems
Jade JG Z80 Board,
1979
Gift of Robert Leffert
X936.88

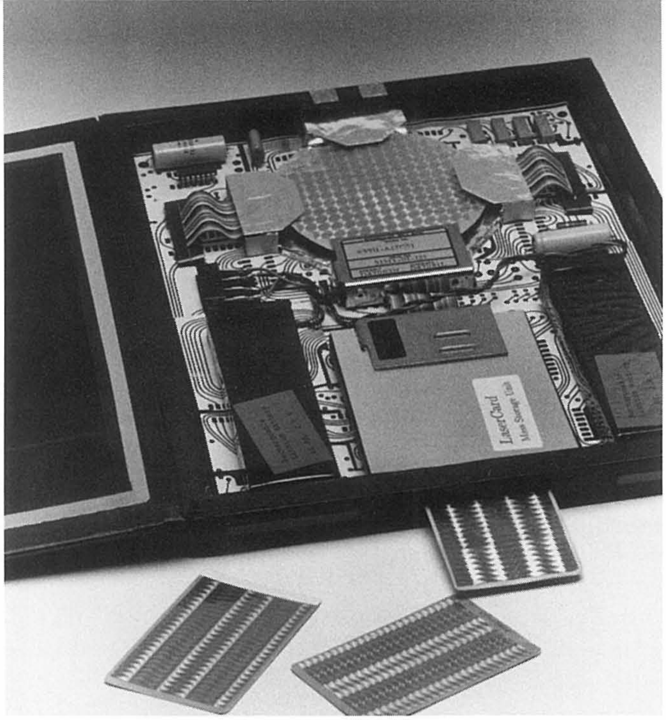
Keypact
Vicro-VIP series
computer terminal,
1978
Terminal in a
Samsonite case
*Gift of The Corris
Company*
X950.88

MITS
Altair Boards, 1976
Gift of Robert Leffert
X935.88

Mountain Hardware
Prorom Board, 1977
Gift of Robert Leffert
X932.88

Bob Mullen's
Extendor Boards, 1978
Gift of Robert Leffert
X937.88

Remington Rand
UNIVAC I circuit
board
*Gift of John Hancock
Mutual Life Insurance
Company*
X862.88



PC of the Year 2000
Luke T. Young, Kurt H. Thearling, Steven S. Skiena, Arch D. Robison, Stephen M. Omohundro, Bartlett W. Mel, Stephen Wolfram, University of Illinois at Urbana-Champagne.

On January 28, 1988, the University of Illinois Team won Apple's competition "PROJECT 2000." John Sculley, Apple's chairman and chief executive officer, stated the purpose: "PROJECT 2000 extended a challenge to students to visualize how computer technology will be used in the year 2000. At the same time we wanted to engage in an enriching educational experience that would lead them to explore the possible social, economic and technological climate of the world at the turn of the century."

Characteristics: Tablet will have the same dimensions as a standard notebook: an 8" x 11" retangular slab. The front screen is a high-resolution touchscreen. A LaserCard replaces the disk media. These will be credit card sized optical RAMS with a single one gigabyte card holding four hours of video or 2,000 books. Tablet integrates a cellular telephone link. Along three sides of Tablet will be an infrared bar interface through which Tablet will talk to its local enivironments: printers and projectors, stereo headsets and video cameras, toasters and roasters, other Tablets and just about anything else. Tablet will have a GPS (Global Positioning System) receiver as a built-in component. GPS is an existing satellite system that enables objects to locate themselves in the world.

From A Day in the Life: "On October 5, 2000, Alexis Quezada sits under a tree, positions her Tablet on her lap, contacts the university's lecture database and begins to view her Conversational Japanese lecture for that day. Tablet allows her to unlock mysteries much as an earlier tablet, the Rosetta stone, provided the key to deciphering ancient Egyptian writing ... "

For the Museum, this acquisition and its predictions will be interesting to examine on October 5, 2000!

UNIVAC I

The UNIVAC I, , Universal Automatic Computer, first delivered in March, 1951, was the most important machine during the early 1950s. It is a single-address, decimal computer with 12 digits/word. Two instructions are stored per word. The primary memory has 1,000 words with ten words per delay line. Addition and subtraction took 525 microseconds.

The main parts of a UNIVAC I were saved by Mr. Lawson, and put in his garage in Goodlettsville, Tennesee, with the idea that sometime it would be important. And indeed, because of his foresightedness, the Museum was able to acquire the artifacts from his widow, Mrs. Sarah I. Lawson.

Professor Arthur Riehl, University of Louisville, and Dr. John McGregor, Murray State University, Murray, Kentucky, and their students have taken the components of the UNIVAC to Louisville for refurbishment for the February Computer Science Conference where it will be on display.

The UNIVAC was the first commercial computer in the United States, although it was predated by the ERA 1101, the first "commercially-sold" research computer, and a contemporary with the LEO 1, produced by the Lyons Tea Company in the UK. Nevertheless, to many people, the UNIVAC I was the first computer that was widely recognized. Its fame came from correctly predicting the landslide 1952 Eisenhower election victory.

The UNIVAC was capable of statistical, scientific, logistical and commercial applications. It produced the Population Tables for the 1950 Decennial Census. Prior to this, the Census had used card accounting processes with each step handled by a person. The computer mechanized these tasks performing all the steps from the initial feeding of the cards to the printing of the tables.

For scientific use, the UNIVAC had a general-purpose matrix algebra routine that could subtract, multiply, and reciprocate matrices of orders up to 300. The UNIVAC was used commercially to handle premium billing for life insurance processing an average policy in less than 0.5 seconds. For logistical purposes, the UNIVAC was programmed to quantify a mobilization plan.

Forty-eight one-million dollar UNIVAC I's were produced. But $1 million was only a fraction of the real cost. For example, for the installation at Franklin Life, they removed four feet of wall between two windows to allow sections of the central computer to be craned in; enclosed 390 square feet for a switchgear room; removed a false ceiling; installed air conditioning in the basement and ran lines to the computer room.

In addition to the costs preparing the computer room, the average installation required hiring 80-100 people. These included supervisors, programmers, coders, librarians, operators, engineers, technicians, and tape handlers.

Sources: J. Presper Eckert, Jr., James R. B. Weiner, H. Frazer Welsh, Herbert F. Mitchell, "The UNIVAC System", AIEE-IRE Conference, 6-26, December 1951; Martin H. Weik, A Third Survey of Domestic Electronic Digital Computer Systems, *Ballistic Research Laboratories Report No. 1115, March 1951.*

Rochester Data Inc.,
Dynatyper, 1978
Electric Typewriter
attachment for
Apple II
Gift of Charles Mann
X914.88

Teleterm Computer
Devices
Computer Devices
Terminal, 1970
Gift of Richard W. Herzfield
X913.88

Thinker Toys
Morrow Speakeasy,
1977
Gift of Robert Leffert
X938.88

Memories

3M
Winchester Disk
Drive, 1981
Gift of David Sager
X909.88

California
Computing Systems
M-XVI 16K
Static Ram
Module Kit, 1978
Gift of Alan Frisbie
X930.88

Cambridge
Memories, Inc.
ExpandaCore 11
Add on memory for
PDP-11/45
Gift of James Prater
X952.88

Control Data Corp
CDC 39 inch
magnetic disk
Gift of Computer Science Department, University of Colorado
X949.88

Compupro
Godbout Memory
Boards
Gift of Robert Leffert
X940.88

Datanet 760
Memory Unit
Bulk Core
Memory Unit
Bulk Core Unit 7600
Delay Line
Interface Card
Memory Unit
Memory Driver
Memory Driver
Gift of Rob Staples
X919.88-X926.88

Dynastor
Dynastor Floppy Disk
Recording Cartridge,
1977
Gift of Ron Hopley
X888.88

IBM
IBM 1401 Disk Pack,
1965, In transportable
"hat-box" suitcase
see photo p. 23
Gift of David S.
Neroda
X887.88

IBM
3350 Direct Access
Storage Device
Gift of John Hancock
Mutual Life Insurance
Company
X865.88

IBM
3851 Mass
Storage Unit
Magnetic "honeycomb" and disk
storage
Gift of John Hancock
Mutual Life Insurance
Company
X863.88

IBM
3851 Magnetic
Cartridge
for the "honeycomb"
storage unit
Gift of John Hancock
Mutual Life Insurance
Company
X864.88

Ithaca Audio
Audio 8K Static RAM
Board, 1977
Gift of Robert Leffert
X934.88

Institute for
Numerical Analysis
National Bureau of
Standards 1951
SWAC Williams Tube,
Gift of Harry Huskey
X872.88

LFE, Laboratory for
Electronics
Bernouli Disk
Memory, c 1960
Spinning mylar disk
with fixed heads
Gift of
Herbert S. Teager
X956.88

Ramo Woolridge
Magnetic drum
Gift of
Herbert S. Teager
X971.88

Raytheon
Four K, 18 bit
Core memory board
Gift of
Herbert S. Teager
X958.88

RCA
Bizmac Magnetic
Drum Ring
Gift of Francis Hjarne
X966.88

RCA
Bizmac Magnetic Core
Elements
Gift of Francis Hjarne
X969.88

Robins
Paper Tape Slicer
Gift of Francis Hjarne
X962.88

S.D. Sales Company
Memory Board, 1976
Gift of Robert Leffert
X939.88

Solid State Music
8K RAM Board, 1977
Gift of Robert Leffert
X933.88

Robots

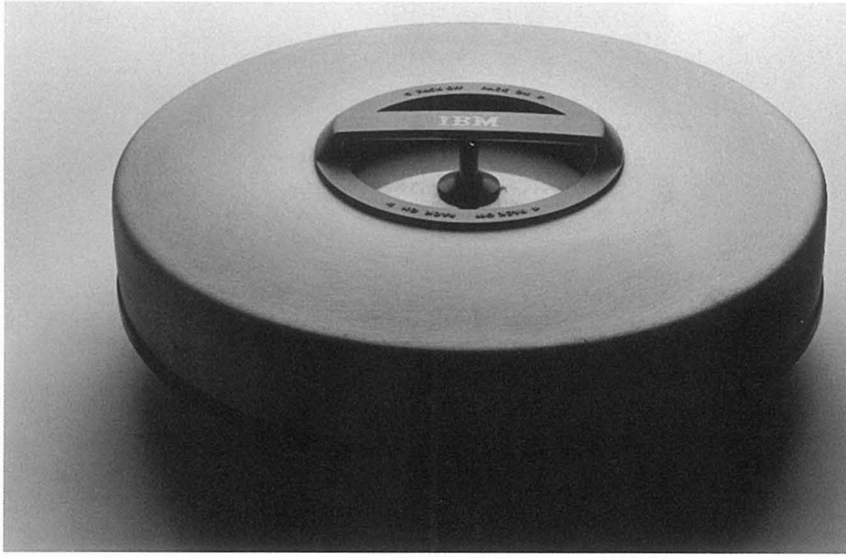
Minsky Tentacle Arm
Gift of Marvin Minsky
X927.88

Tandy Electronics
Robie Jr., 1986
Remote controlled
talking "robot"
Gift of Tandy
Electronics
X945.88

Tandy Electronics
Mobile Armatron
Remote control
robot arm
Gift of Tandy
Electronics
X946.88

Electronic calculators

Casio, Inc.
Casio fx-7000G
Scientific Calculator,
1986
Gift of Casio, Inc.
X902.88

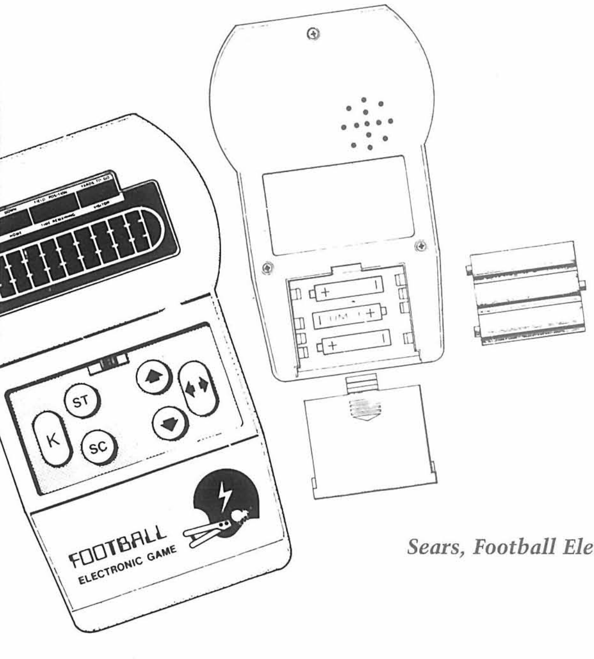


IBM 1401 Disc Pack
A portable "hat box" disc pack was devised so that programs and data could be carried from site to site.

Olivetti Programma 101

The Programma 101 produced in 1968 is one of the first desk-top electronic calculators that is almost a computer. It has a sufficient instruction set to be classified as a computer, but the storage for temporary data, constants, and programs is limited. This calculator was programmed using special magnetic cards.

The Programma 101 costing $3,500 in 1968 is slightly less expensive than the HP 9100A, the contemporary desk calculator that is almost a computer. The program library for the Programma 101 was extensive with many multiple card large FORTRAN programs.



Sears, Football Electronic Game

Gillette Company
GPA Calculator PC-1
Gift of Gary Boone
X904.88

Litronix Inc.
Litronix 1602, 1975
Four-function
electronic calculator
Gift of Gary Boone
X905.88

Litronix, Inc.
Litronix 2200 Series,
1975
7 Electronic
Calculators
Gift of Gary Boone
X907.88

Olivetti Underwood
Programma 101, 1965
Desk top size
see photo p. 24.
Gift of Leslie Meyer
X915.88

Summit International
Corporation
Summit Calculator
MB-8, 1972
Gift of Gary Boone
X903.88

Texas Instruments
TI-1200,
Gift of John McKenzie
X928.88

Microprocessor-based devices

Adidas
"Micropacer"
Running Shoes, 1985
see photo p. 25
Gift of Adidas
X901.88

Coleco Industries
Talking Wrinkles,
1981
Gift of Coleco
Industries
X944.88

Milton Bradley
Comp-IV, 1978
Based on "Mastermind"
Gift of Tom Restivo
X868.88

Parker Brothers
Merlin, 1978
Includes Blackjack 13,
TicTacToe,
and Follow the Leader
Gift of Tom Restivo
X871.88

Sears
Football Electronic
Game, 1979
see illustration p. 24
Gift of Tom Restivo
X869.88

Sears
Electronic Basketball.
1979
Gift of Tom Restivo
X870.88

Seiko
World Time Clock,
1987
Gift of Seiko
X931.88

Waddington House of
Games Inc.
Wizard, Model 2004,
1979
Gift of Tom Restivo
X867.88

Slide rules & calculators

Air Express
"Air Express Shipping
Estimator"
Circular Slide Rule
Gift of
W. Thomas Wagner
X889.88

The Carpenter Steel
Company
"Carpenter Stainless
Tubing"
Slide Rule
Gift of
W. Thomas Wagner
X892.88

Dwyer Instruments
"Air Velocity
Calculator", 1972
Slide Rule
Gift of
W. Thomas Wagner
X890.88

E. I. Dupont Company
"MYLAR Cost
Comparator"
Slide Rule, 1956
Gift of
W. Thomas Wagner
X894.88

Freemont and Lewis
Inc.
Hoffman Slide Rule
No. 601UTO
Gift of
W. Thomas Wagner
X900.88

Jeppesen and Co.
"Jeppesen Computer"
Model R-2
Circular slide rule for
pilots, 1955
see photo p. 25
Gift of
W. Thomas Wagner
X896.88

Kieley and Mueller,
Inc.
"Valve Capacity
Calculator", 1947
Slide Rule
Gift of
W. Thomas Wagner
X893.88

Keuffel & Esser
Company
Polyphase Slide Rule
Gift of John McKenzie
X929.88

IBM
Hexadecimal Adder
Gift of S. Lester
Ungerleider
X879.88

Lightning Manufacturing Company
Lightning
Adding Machine
Gift of Irwin Sitkin
X875.88

Perrygraph Corp
"Reynolds Wrap
Time-temperature
Cooking Guide", 1959
Slide Rule
Gift of
W. Thomas Wagner
X897.88

Redi-Mix, Inc.
ACU-Math Concrete
Calculator
Slide Rule
Gift of
W. Thomas Wagner
X891.88

Rockwell Manufacturing Company
"Rockwell-Nordstrom
Multi Port Valves"
Demonstration
Slide Rule
Gift of
W. Thomas Wagner
X898.88

Safety Grinding Wheel
and Machine
Company
Guedon Slide Rule
Gift of
W. Thomas Wagner
X899.88

Textron Electronics
Inc. 1960
"Vibration
Computer",
Slide Rule
Gift of
W. Thomas Wagner
X895.88

Ephemera

Charles Andres
"CPU Wars"
see illustration p. 26
Gift of R. D. Mallery
X883.88

Berger Associates
OPM Silk Tie
Gift of Philip H. Dorn
X885.88

Burroughs
Burroughs Compilogram, 1961
Gift of Philip H. Dorn
X878.88

Button Collections
Gifts of
R. D. Mallery;
X882.88
G. Edward Bryan;
X884.88
Phil Dorn;
X886.88
Francis Hjarne:
X970.88

IBM
IBM Flowcharting Templates
Gifts of
Jack Meyerowitz;
X873.88
John J. McCaffrey
X955.88

IBM
Sign
"IBM Scheduled Preventative Maintenance in Progress"
Gift of John J. McCaffrey
X954.88

IBM
Plant Tour Book
Gift of Francis Hjarne
X961.88

IBM
"Think" sign
Gift of Francis Hjarne
X963.88

IBM
"Think" sign and holder
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"Think" notepad
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Time clock card, 1956
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519 document originating machine plugboard
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Mudge, Rose, Guthrie, Alexander & Ferdon
The PDP-1, Space-War!, 1988
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WGBH, NOVA
Artists in the Lab,
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The Robot Revolution?, 1986, *VT 182.88*
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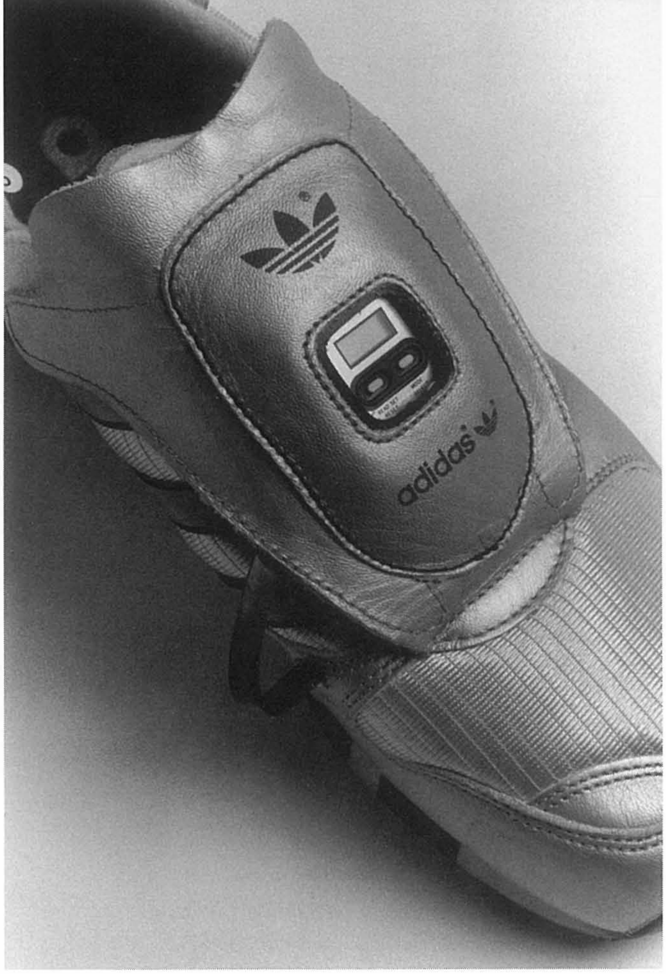
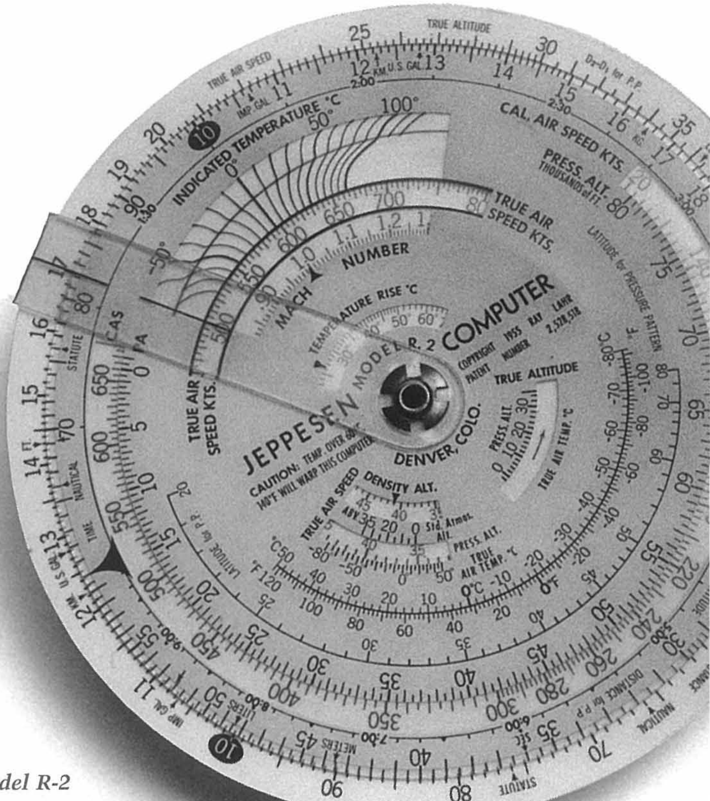


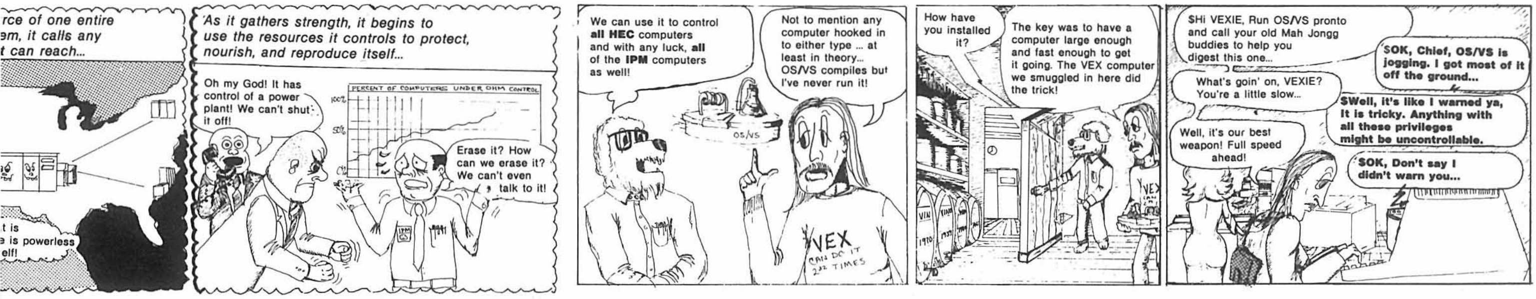
"Micropacer" Running Shoes
The shoes calculate speed, distance and caloric output.



"Jeppesen Computer" Model R-2
A circular pocket calculator for aviators.

CPU Wars

This "comic book" was created in the seventies by an engineer at Digital Equipment Corporation and later published by DECUS.

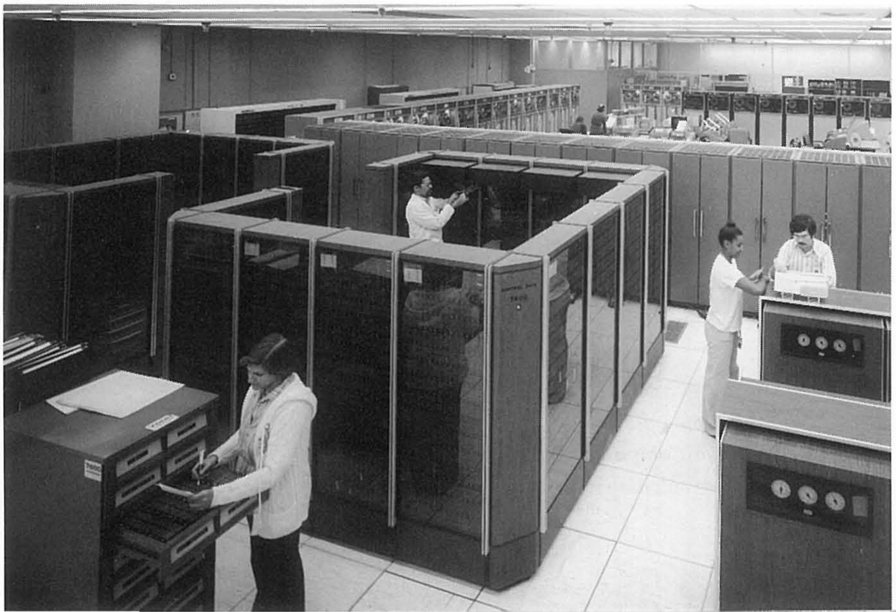


CDC 7600, Serial Number 1

Serial number one of the 7600 was delivered to Lawrence Livermore Laboratories in November 1969 where it became the center of the "Octopus" network that tied together many of the computers. It operated until October 1988 when it was "cut out of the system." The cables in the Octopus network running under this floor were literally cut, when the system was taken down.

The Museum acquired two processor segments and one fake wood corner piece. A second corner set is on display at The Computer Museum in Livermore that has samples from all the benchmark machines at the laboratory. A visit may be arranged by contacting Barbara Costello at the Laboratory.

The CDC 7600 is an upwardly compatible member of the CDC 6000 series designed by Seymour Cray. Its predecessor, the CDC 6600 (also in the Museum's collection), was the first commercially successful super-computer. The first 6600 was delivered in September, 1964, and the 7600, delivered in 1969, was four to six times faster. Both computers had densely packed "cordwood" modules that were cooled by conduction to a plate with Freon in it. Although integrated circuits had been used in computers, both machines used discrete transistors and core memory.



Documentation & photographs

The documentation is divided into two parts. The Museum has a small library and an archive of documentation. The library includes books relating to the collecting areas of the Museum, computer history and reference books. Of particular interest are the books on computers and computer architecture from the 1960s and 1970s. Some consider these books outdated, but the Museum was happy to accept such books from the Boston Museum of Science Library and would be pleased to receive other additions.

The archives document the computers in the collection and the ones that we would like to have in the collection. The Museum has also extended archives on special collecting and exhibiting areas, such as computer graphics, artificial intelligence and robotics.

Charles Jortberg Associates, and particularly Ann Russell, has been assisting the Museum in developing a data base of the archival material. By the time of the next *Annual*, we should have an active searchable data base on the holdings.

This coming year, the Collections Committee will consider various aspects of the software issue including documentation. All of the language manuals from the Museum have been sent to the collection assembled by Jean Sammet.

The Charles Babbage Institute for the History of Information Processing documents the location of major archives and also collects in this area.

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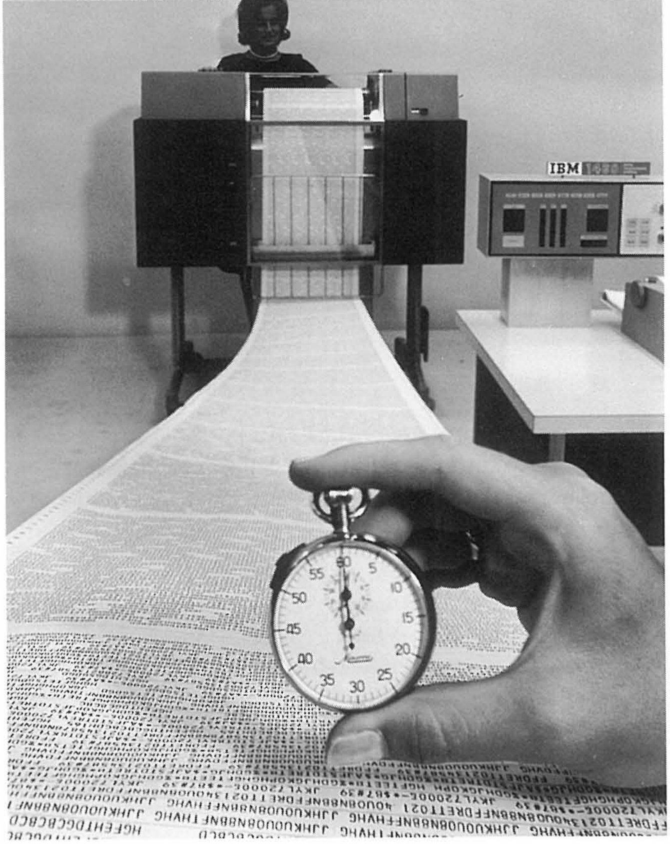

Historic photograph of IBM 1460 printer
"This new, 1963 printer, is capable of producing 1,100 lines of alphabetic and numeric information in one minute."

Sanders Associates *electronic assembly line, c. 1970.*

CAPITAL CAMPAIGN

It takes the financial commitment of many individuals, businesses, and government agencies that believe in an institution's vision and programs to keep things going. The Computer Museum gratefully acknowledges the support of those listed here and hopes that this list will inspire others to join them in supporting The Computer Museum programs.

PHASE 1

Donors to the first phase of the capital campaign had the faith to buy into a concept before there was an actual product. They provided the seed capital needed to open the Museum in its present facility in Boston in November, 1984. Their support helped refurbish the building and develop the first set of exhibitions. At the campaign close in April 1988, $3.3 million has been raised.

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PHASE 2

Donors to the early stage of the second phase of the capital campaign have contributed funds needed to buy the building, develop the second set of exhibits, and begin building an endowment that will ensure the future of the Museum by providing long-term finanicial stability.

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- John William Poduska, Sr.
- Xerox Corporation

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- MITRE Corporation
- National Computer Graphics Association
- David & Patricia Nelson
- Unisys

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- Robert Hoffman
- Ted Johnson
- Harold Judy
- James McKenney
- Meditech
- Thomas F. Stephenson

__Spacewar__ inventor Shag Graetz at the console of the PDP-1. Graetz joined dozens of other pioneers at the Museum's symposium on the 25th Anniversary of Computer Games.

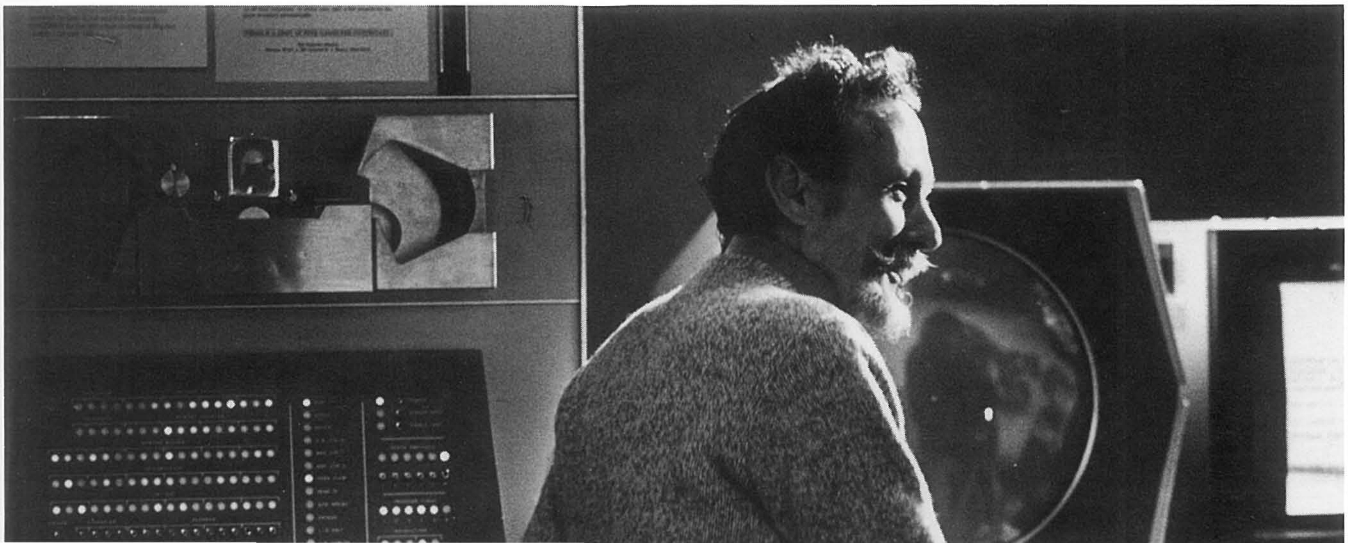

Exhibit engineer Dan Griscom repairs the Denning Sentry Robot, which is used in one of the Museum's daily public demonstrations.

ANNUAL FUND '88

The Annual Fund is comprised of gifts from individuals, corporations and other friends which are pooled to help offset annual operating expenses. The fund helps our programs flourish while allowing us to reach new audiences and continue serving as an international resource for computer research and education. Continued growth of the Annual Fund is important as the Museum expands its services.

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Education Coordinator Michael Chertok brings a robot workshop on the road to classrooms throughout New England – one of several outreach programs provided by the Museum.

Corporate members support the Museum annually through participation in this program. Member corporations are recognized in our bi-monthly newsletter and receive a sliding scale of benefits. These include free admission passes; individual memberships for corporate designees; the opportunity to use the Museum for corporate functions; use of the Museum's archives and the ability to participate in the Museum's Collection Loan Program.

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National chair Pat Nelson coordinates Computer Bowl volunteers from coast to coast.

THE COMPUTER BOWL

The World's First Computer Bowl is now a bi-annual international event to raise funds for The Computer Museum's educational programs. The full story of the Bowl can be found on pages six and seven of this Annual. The Computer Bowl was successful because of the founders, sponsors and volunteers listed below who gave so generously of their money, time and ideas. They helped set a standard of excellence for the next Computer Bowl, to be held in early 1990.

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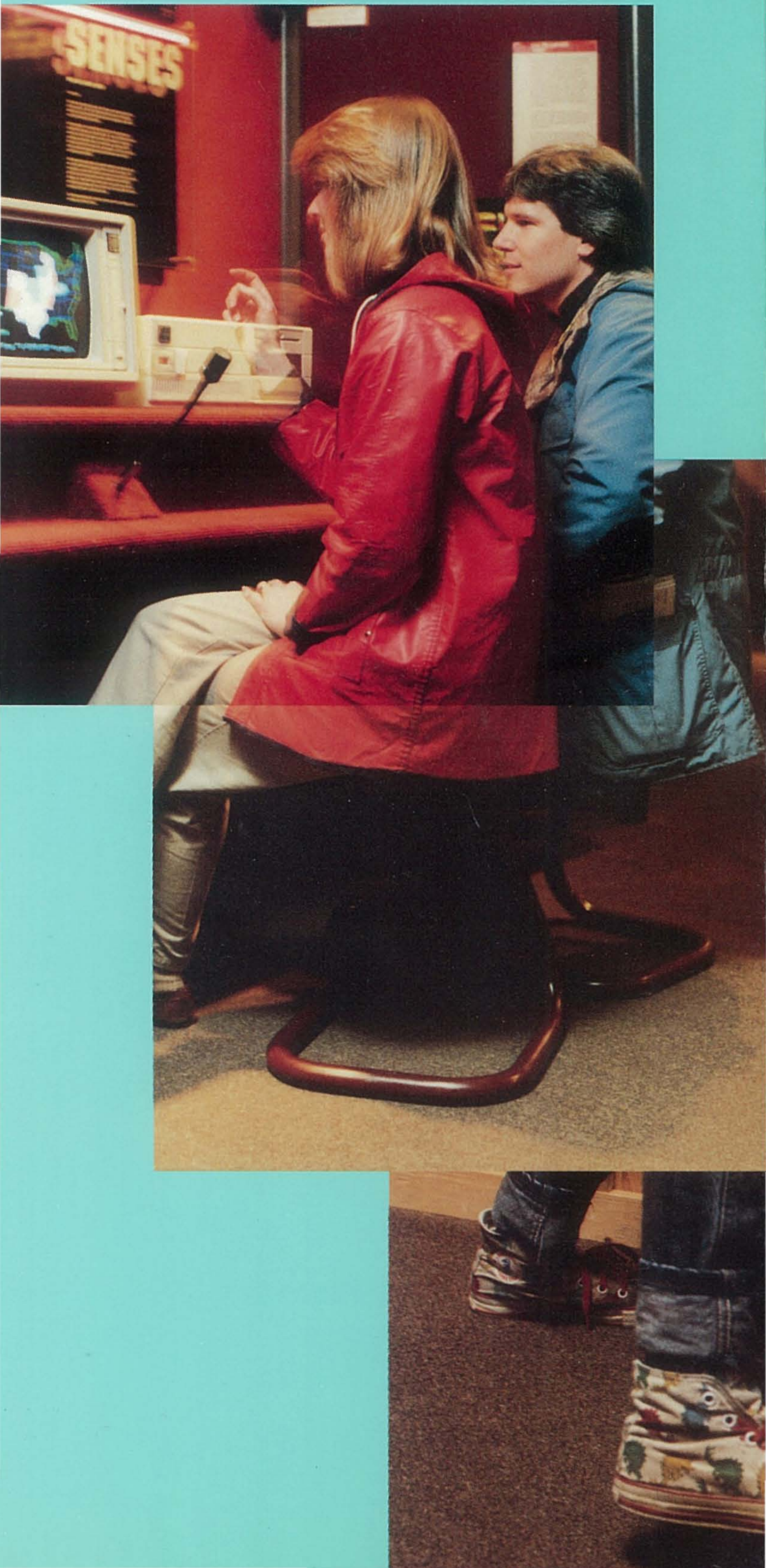
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